Railway Mechanical Engineer

Vol. 98 March, 1924 No. 3

Successful Shop Management

Probably no competition that we have ever held presented a more difficult problem to the judges than did the one on shop management—this because of the great differences in the character and contents of the contributions. The first and second articles have already been published. One of the contributions which will be found elsewhere in this issue, prepared by A. Montangie, was highly commended by the judges. It deals with the psychological factors in management and is exceedingly well written and logically arranged. It is noteworthy, also, for another reason—it is one of the very few contributions to our competitions which we have ever received from a foreign land. The writer is connected with the mechanical department of the Belgian State Railways, and in his letter of transmittal indicates that he has had an opportunity of trying out the principles outlined in his article with excellent results. For these reasons the article should possess a peculiar interest for our readers.

Machine Shop Competition Closes April 1

The closing date for submitting contributions to the machine shop production competition is April 1. Details of this competition were announced on page 70 of the February *Railway Mechanical Engineer*. Since machine shop work on rods, motion parts, and driving boxes constituted three of "the key jobs of all those capable of being organized on a production basis," it is hoped that many shop foremen and others interested in the rapid, orderly handling of this work will describe their methods for the mutual benefit of all our readers. What is the correct arrangement of machinery? What machine is best adapted for each important operation? Most important of all, how are your men organized for handling the work? Are you getting the output you ought to from your rod, motion work, or driving box gangs compared with the number of men employed in each? If you are, tell us about it and perhaps win one of the $50 prizes. If your article is not awarded a prize, but is published, in whole or in part, it will be paid for at our usual rates. The judges will base their decision on the practical value of the material in the article. Don't forget the closing date is April 1, and send all contributions to the *Railway Mechanical Engineer*, 608 S. Dearborn street, Chicago, Ill.

Elimination of Waste Contest Prize Winners

In our October and November issues, we announced a prize contest for the two best papers on the elimination of waste, submitted before November 15. The conditions of the contest called for the description of specific instances where waste, either of material, labor or the use of facilities, had been eliminated, and the prizes were to be awarded on the basis of the practical value of the suggestions. A surprisingly small interest was shown in this subject and only two papers were submitted. These papers approach the subject from quite different viewpoints. One outlines a change of practice with respect to one locomotive part, which has effected a quite definite saving. The other calls attention to a fundamental cause of serious waste, which, however, is beyond the control of mechanical department supervisors and at least some of the executives themselves. For the reason that the former adheres more closely to the conditions outlined, the first prize has been awarded to the author of that paper, Millard F. Cox, mechanical engineer, Louisville & Nashville, and the second prize to D. M. Raymond, car foreman, Union Pacific, whose paper is worthy of the most careful consideration even though it is devoted to pointing out faulty conditions rather than to suggesting a practical means of improving them. The papers will appear in early issues.

Adopt Standard Truck Levers

A number of years ago, after careful investigation followed by concerted agitation on the part of quite a few men responsible for the maintenance of air brake apparatus, several leading railroads adopted standard truck levers and specified such levers on all orders for new freight equipment. With varying designs of trucks, it is not, of course, possible to use a single length of lever in all cases; neither is it possible with all designs to make the live lever and the dead lever on a truck of the same length. However, it is fundamntal and universal to make both the live and dead levers on a truck of the same proportion. Thus, if the proportion adopted as a standard was 4 to 1, the live lever might have lengths of 7 in. and 21 in. and the dead lever 6½ in. and 19½ in. The adoption by a road of a standard proportion for truck levers and using such a standard on repeated orders for freight cars, tends to reduce the possibility of the substitution of wrongly proportioned levers when making repairs and thereby contributing to the possibility of slid flat wheels. Such a mistake as this has been made far too many times by the men who are available for such work. Should the mistake, however, be one simply of length and not of proportions, the distribution of brake shoe pressure would not be disturbed, and such a substitution would generally be advisable if it expedited repairs. Furthermore, it would not be necessary to carry such a varying stock of spare levers at many points or levers that have to be drilled before they can be applied. The proportion of 4 to 1 mentioned may not be considered by all roads as the most desirable one; some roads adopted 3½ to 1 and some as low even as 3 to 1, but it is generally conceded that the proportion should not exceed 4 to 1 in order to avoid excess angularity.

A recent examination made it evident that at the present time many large systems were not adhering to any fixed standard proportion. This point apparently was given due consideration, however, by the A.R.A. Committee on Car Construction for on the drawings for the standard box car the truck levers are shown as 7½ and 18¾, a proportion of

3½ to 1. All roads which thus far have not adopted standard truck levers should consider the advisability of the adoption of this proportion for the truck levers of all new freight equipment. Even those roads which have only partially adopted some other standard ratio would do well to consider the advisability of specifying a ratio of 3½ to 1 on future orders and thus gradually reduce the confusion that now exists in maintaining cars in interchange.

Broadening the Vision of Apprentices

Among the excellent practical suggestions for improving apprentice training made by F. O. Robinson in his paper which was awarded honorable mention in the regular apprentice competition, and which is printed on another page of this issue, is one of a rather unusual nature. It is suggested that business men and educational authorities be brought in occasionally to speak to the boys on topics outside of shop subjects and which will tend to broaden their viewpoints and help to develop their characters along the right lines.

While this has been done in a few instances, and in a more or less limited way, it will undoubtedly come to some people as a rather radical suggestion. The value of these things to the boys can hardly be over-estimated, particularly where the shops are so located that such talks are infrequent in community or other gatherings which may be open to the apprentices. The value of these talks is greatly increased when they are given to the apprentices as a group, and particularly when they are followed up by open discussions, or at least an opportunity is given of asking questions. There are many business and professional men who are splendidly fitted to be helpful in speaking informally to a comparatively small group of this sort and who would feel it not only a duty but a privilege to be helpful in this way.

Is this suggestion practical? Is it worth while? We shall be glad to hear from any of our readers who have attended such meetings and have been helped by them. Please don't stand on ceremony, but drop a note to the editor about your experiences. If Mr. Robinson and the other men who write on apprenticeship, or on other subjects, make worth-while suggestions that you can support from your experience, let our readers know and thus help the good work along. If, on the other hand, you believe the suggestions are not practicable or will not be helpful, let our readers know, in order that others may be kept from making useless mistakes.

Enginehouse Foremen Overworked

No man can do his most efficient work unless he keeps himself in prime condition. This he cannot do if he works unreasonably long hours every day and if he is forced to work every day in the week. This was clearly demonstrated by the report which was made under the auspices of the Federated American Engineering Societies on the Twelve-Hour Shift in Industry. The enginehouse is in most cases the neck of the bottle in railroad operation. Larger and larger locomotives have been introduced, and the number of locomotives has been increased, but without a corresponding increase in enginehouse size and facilities. The average enginehouse foreman is worked almost to the limit of his endurance. These men are giving a remarkable account of themselves, but are they being given a square deal, and might they not in many cases be able to handle their positions far more efficiently if their working conditions were improved and greater recognition given to their importance in the organization? The following quotation speaks for itself.

"The roundhouse foremen on this and other lines are required to work eleven hours a day, seven days a week. A man who stays close to the work and watches closely is certainly under a mental strain, and eleven hours is too long to stand it every day in the week. Dispatchers and operators are limited in their hours of service for a good reason, but a roundhouse foreman can overlook a detail and wreck a train or explode an engine. I would like you to show the railroads that it would be profitable to work the engine terminal foremen not over nine hours a day at 50 per cent above the highest paid mechanic. The world at large, especially industries, has found that mechanics do not perform efficiently when worn out, so why should a roundhouse foreman perform even satisfactorily at mechanics' pay and long hours?"

In this connection our readers may be especially interested in the article on "The Fatigue Element in Accident Prevention," which will be found elsewhere in this issue.

Waste in Car Repairs—A Competition

Did you ever take a look into some car repairman's shanty and see a keg of bolts or nails that had been broken open with a maul and the contents strewn all over the floor? If you did, perhaps a further inspection revealed an old box full of lag screws, uncoupling lever links, a few air hose couplings, along with other odds and ends of usable material. In walking around the shanty, you may have stumbled over a varied assortment of couplers, knuckles, and "what not," thrown together in a pile or half buried in the ashes. Inspection periods on this line were either long and far between, or the responsible car department officer did not consider this car repair point important enough to bother with. In a stroll through the country, you may have notcied a front gate fastened with a bolt and staple intended for a box car and as you entered the village, you noted further that the device seemed to be quite popular for garage and barn doors, as well as gates. Upon recollection, you remembered that there was a box of door fastenings among the pile of junk beside the car repairman's shanty.

A few days later, you might have had occasion to visit another outlying car repair point. There was the same style of shanty. Yet there were evidences of an attempt to keep the material in some sort of orderly arrangement. The foreman evidently appreciated the advantages to be obtained by doing his work in an orderly fashion. There was a platform outside for storing couplers, brake beams and other heavy material; racks for tie rods, brake rigging and air cylinders, and bins for small parts. It seemed there was a place for everything and everything was in its place, yet the bins and racks were not arranged in logical order. You might have continued your journey around the yard and down the repair track and noted the apparatus and various appliances used in the work, and you might have had your doubts as to some of them getting by the safety inspector. However, you must have gotten a lot of good ideas as to the kind of facilities and practices that would improve conditions at these outlying car repair points.

In order to give you just the opportunity to put some of these ideas across, the *Railway Mechanical Engineer* is offering two prizes: one of $50 for the best article, and another of $35 for the second best article on the elimination of waste at outlying car repair points. Even if you should not win either of the two prizes, there is a chance of your article being published if it contains some good ideas or suggestions. In case the article is published, it will be paid for at the regular space rates. Articles will not be judged on their literary merit, but on the value and practicability of the methods described.

From the standpoint of economy and efficiency, this subject is of timely importance. How do you think such conditions can be improved? Would you propose standard buildings and methods of storing material for an entire sys-

tem? What limitations would you impose as to the kind of work to be done at outlying points? There are a number of questions that ought to be answered and perhaps you may think that your road has solved them all. If so, here is your chance to tell us about it. Photographs and drawings go a long way towards telling other folks what you have in mind, and if you really desire to convince the other fellow, be sure that your article is well illustrated. Papers entered in this competition must be mailed on or before May 1. Address them to 30 Church Street, New York.

Evidence of Unfair Usage

Approximately one-half of the cases that are brought before the Arbitration Committee for settlement involve some application of Rule 32. The majority of the cases do not require an interpretation of the rule, but are primarily questions of fact relative to which the disputing parties cannot agree. It is rather difficult to determine the circumstances that caused the damage and, in order to decide the case, it is necessary that a complete knowledge of all the facts be had. The failure to collect complete evidence at the time of the accident is noticeable in practically every case where the question of unfair usage comes up.

Rule 32 is quite specific as to what constitutes unfair usage and the decisions of the Arbitration Committee show a tendency to assume that the existence of any of the conditions cited in the rule is proof that this condition is the primary cause of the damage. However, this tendency does not exist in cases where derailment, wrong signals or lack of rider protection are given as the cause of the accident. As was brought out in a previous editorial in the *Railway Mechanical Engineer*, there are cases of damage for which this strict interpretation of the rules makes the handling line responsible, where equipment of better construction undoubtedly would not have failed. It seems, therefore, that the burden of proof is placed to a large extent on the handling line. As a matter of policy, it should, in such cases, collect proper and sufficient evidence to prove without a doubt that none of the conditions named in Rule 32 exist. Until the railroads take cognizance of the fact and educate their employees to the importance of obtaining complete evidence at the time of the accident, there probably will continue to be little prospect of the handling line obtaining a favorable decision.

Support Railway Clubs and Associations

The educational possibilities of railroad clubs and minor mechanical associations are greater than generally recognized, and higher mechanical officers can do much towards the more complete realization of these possibilities by encouraging active interest and membership in such organizations. Their prime object is certainly worthy—to stimulate among railroad men an alert and intelligent conception of their duties and responsibilities in our highly developed transportation system. Several outstanding advantages of membership in these organizations come to mind.

Co-operation results from personal contact. Co-operation means working and acting together in the promotion of the same end, and this end, as far as mechanical department work is concerned, consists of keeping cars and locomotives in condition for the safe, economical and prompt transportation of freight and passengers. One of the prime requisites of co-operation is a clear understanding of mutual problems and how to meet them, and the best way to get such a mutual understanding is by membership in, and faithful attendance at the meetings of the various associations covering the different branches of railroad mechanical work. It cannot be denied that many troublesome controversies are avoided and difficult problems surmounted to the satisfaction of all concerned whenever a group of men interested in the same line of work can get together and talk things over. It would frequently take an indefinite period, if, indeed, it did not prove impossible, to bring about the same result by correspondence.

Uniform practice and interpretations are promoted. The rules governing the interchange of, and repairs to cars, for example, are from year to year becoming more intricate as a natural result of changing conditions, improvements of equipment and increased traffic requirements. No agency plays a more important role in the proper and sane interpretation and application of these rules than the car inspectors' and car foremen's associations by their "get together" meetings. The influence of such organizations as the Chicago Car Foremen's Association with a membership of over 10,000 receiving the proceedings of the monthly meetings may readily be appreciated. Full and frank discussion, and information from authentic sources explaining the necessity of apparently inconsistent requirements of the rules, result in many leaving the meetings with a more definite understanding of the intent and spirit of the rules. Also many important modifications, based on the experience of the membership, result from the recommendations made by these associations.

Education is afforded in the various phases of mechanical work. Papers on technical and practical subjects, presented at the meetings by authorities on such subjects and freely discussed, are an education in themselves and help to broaden association members who are not so familiar with, but in a more or less general way have supervision over, the particular phase of work under discussion. The subjects selected are pertinent to mechanical department activity and the attempt is made not to have them of too technical a nature for the membership to whom they are presented. When such papers, and the discussion following their presentation, are published and distributed to the membership they become a permanent and valuable source of information for future reference.

The railroads are benefited. If the benefits of mechanical association membership are great to the individual they are also of prime importance to the railroad which employs him. Few things in life give a man more satisfaction and genuine pleasure than "knowing his stuff and doing it" and nothing is more conducive to efficiency and morale in any organization than encouragement from the "higher ups" to their subordinates on the firing line in their endeavor to gain a keener knowledge of their chosen line of work.

Railway Club Discusses Shop Scheduling

At the December meeting of the Western Railway Club, L. C. Bowes, production engineer of the Rock Island, read a paper on "Locomotive Scheduling and Production Control," dealing with the system recently established at Silvis shops (published in five installments in recent issues of the *Railway Mechanical Engineer*). The intense interest in the subject of scheduling work through locomotive repair shops was shown by the fact that at the time of adjournment so many members wanted the floor that it was decided to continue the discussion at the March meeting.

There is good reason for the interest in shop schedules. Railroad shop costs are unquestionably high and in too many cases it is not known just how high they are. Mr. Bowes' paper showed that, with the schedule in operation during a period of five months, the number of man-hours required to give locomotives heavy repairs at Silvis shops were reduced 33 per cent and the actual locomotive output increased 23 per cent. The days of hit-or-miss shop operation are numbered and it is no longer sufficient to call foremen to a weekly meeting and give them a list showing the order in which locomotives are to be turned out during the next week. This method savors of the lack of system found in a certain railroad shop

not so long ago. Noting the large amount of shop order work scattered about the machine shop floor, the foreman was asked how he knew on which shop order to work first. He replied, "I wait until they wire me for it."

Multitudinous schedule forms and unnecessary detail are highly undesirable and form perhaps the main reason why some railroad shopmen of the old school still cling to their objections to shop scheduling. Experience shows, however, that between the extremes of too much and too little system, there is a happy medium, the application of which means an important increase in shop output at decreased unit cost.

The following is an actual case, the facts regarding which can be substantiated. A certain railroad shop in 1909, previous to the installation of any schedule system, required from 20 to 30 days to give a locomotive heavy repairs. A shop schedule, known as the Gardner System, was installed and operated, with only partial success, from the drafting room. A schedule man was developed who spent his entire time in the shop and by 1913 the repair time had been reduced to 14 days. In 1914 a new modern-equipped shop was completed for this railroad at another point and, with essentially the same schedule system to co-ordinate properly the operations in the new shop, the time for giving a locomotive new flues and heavy repairs to machinery was reduced to eight working days. The reduced unit cost in repairing these locomotives can be readily appreciated and in addition they were returned to revenue-earning service with what was probably a minimum loss of time consistent with thorough repairs.

It is perfectly possible to install a schedule system without an objectionable number of forms to fill out and clerical work to unload on the foremen. Correspondence can and should be reduced 50 per cent in many railroad shops. One superintendent of a shop turning out over 40 locomotives a month knows how the work is progressing on every locomotive in the shop by means of a small board on his office wall. This man writes not more than six letters a week to his foremen and visits the shop himself only at infrequent intervals. Who will say that the shop schedule does not relieve him and his foremen of details and allow them to perform their real function of supervising?

The question of shop scheduling is strictly up to foremen and shop officers. If they install the right system and believe in it, it will save them much detail and hundreds of steps daily. If they don't believe in it and give it hearty support, it can never be a success.

New Books

MASTER BLACKSMITHS' PROCEEDINGS. *Edited by William J. Mayer, Secretary, 2347 Clark Avenue, Detroit, Mich. 147 pages, 5½ in. by 8 in. Bound in cloth.*

This book contains a report of the proceedings of the twenty-seventh annual convention of the International Railroad Master Blacksmiths' Association, held at the Hotel Sherman, Chicago, August 21, 22 and 23, 1923. The report of the proceedings has been carefully edited by Mr. Mayer and many papers are included which will be of interest and value to blacksmith foremen and others interested in the work of the blacksmith department. Considerable attention, for example, is given to the respective fields of the Thermit, oxyacetylene and electric welding processes in railroad shops. The book is illustrated.

SHAPE BOOK OF THE CARNEGIE STEEL COMPANY. *346 pages, 5 in. by 7½ in., illustrated. Flexible binding. Published by the Carnegie Steel Company, Pittsburgh, Pa.*

This volume is the ninth edition and is available to users of steel. The new edition is the result of a thorough check and revision of all the sections rolled by the Carnegie Steel Company on its shape, rail, bar and plate mills, and while no important changes have been made in the regular sizes of structural and bar mill sizes of beams, channels, angles, tees and zees, a number of changes have been made in the large number of special sections rolled by that company, such as concrete reinforcement bars, window and casement sections, automobile rim sections and other miscellaneous bar mill sections. Certain rails and splice bar sections, which have become obsolete since the issue of the preceding eighth edition, have been eliminated in the present issue.

What Our Readers Think

Three Cylinder Locomotives

LONDON, Eng.

TO THE EDITOR:

The letter from George L. Clouser in the December issue of the *Railway Mechanical Engineer*, was read with interest. If my recollection serves me rightly, the Erie & Wyoming Valley had a three-cylinder simple locomotive in service some 20 years ago. It is my impression that this locomotive was of the 2-6-0 type and had three cylinders, the diameter of which was 17 in. A. M. BUSHELL.

(While the first conception of the three-cylinder locomotive was probably of English origin, the first application appears to have been made in 1847 on the Philadelphia, Wilmington & Baltimore. About 1880 the Pennsylvania Coal Company built four small three-cylinder switch engines for service around their mines. Another locomotive of the 4-4-0 type with 15-in. cylinders was built in 1892 for the Erie & Wyoming Valley, now part of the Erie system. In 1894 the Baldwin Locomotive Works built three more locomotives of the 2-6-0 type for the same road. These had 17-in. by 24-in. cylinder and are the ones referred to by Mr. Bushell.—Editor.)

"What Is Wrong with This Picture?"

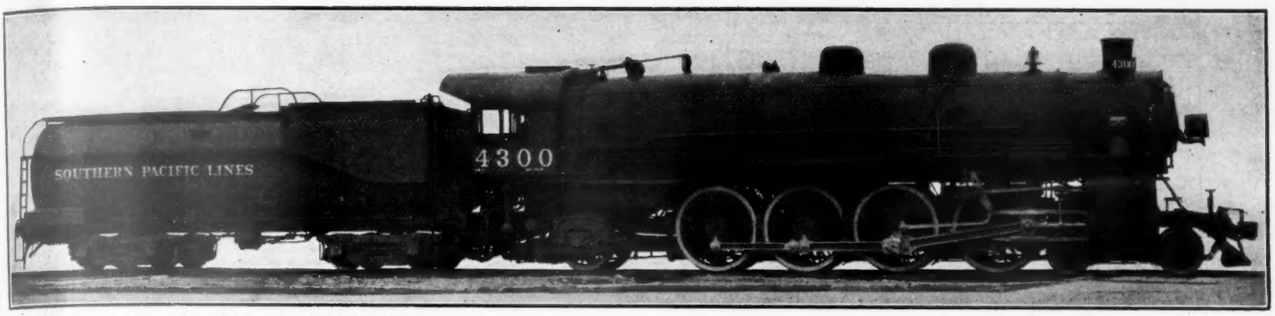
CHICAGO.

TO THE EDITOR:

I was much interested in the article on welding and cutting on page 88 of your February issue, particularly in the gentleman shown welding on pages 88 and 90. I must say that his attitude of perfect complacency, benign and bland assurance and calm repose, as he stands with head erect, fine beaver hat sitting quite pleasingly over a smiling face, with immaculate white collar, a fine fitting coat and well creased trousers, represents an epic—a wonderful tribute to the rapid advancement in the art and science of the use of the acetylene torch. Perfect indeed has this art been developed—goggles needed no more. There he stands, with his steady ungloved right hand welding a cast steel truck side. How simple and easy it must be. We find still more to admire, for, on page 90, he is shown to be ambidextrous: with his left hand, also ungloved, here we see him welding a coupler.

So interesting a study in the autogenous art should not lightly be passed by, hence I hasten to pay my tribute to the gentleman himself and to the artist and the editor who present him. OBSERVER.

(With apologies to the man in the photographs and to the artist who took them, we cannot refrain from printing the comment of our correspondent on the etiquette of the torch. —EDITOR.)



The Locomotive That Makes the **815-Mile Run**

Southern Pacific 4-8-2 Type Locomotives

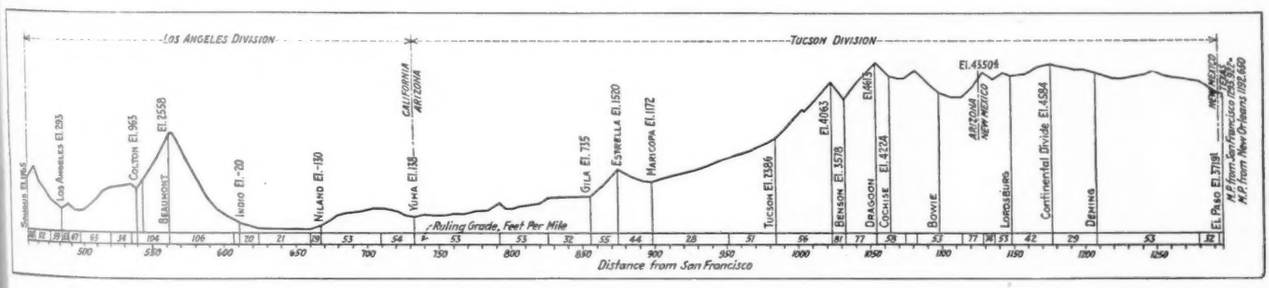
Designed To Haul Trains of Twelve Passenger Cars on Two Per Cent Grades and Run 815 Miles

EARLY in 1921 the Southern Pacific placed in service a number of powerful 4-6-2 type locomotives* that hauled 11 heavy passenger cars on a 1.5 per cent grade and established a record for long locomotive runs. These locomotives have been regularly hauling passenger trains between Ogden, Utah, and Sparks, Nev., a distance of 536 miles, and have averaged better than 10,000 miles per month, fully meeting the expectations of the Southern Pacific in adopting a longer stroke for superheated passenger locomotives, thus keeping down cylinder clearances and obtaining a more economical steam consumption. In this respect, the Southern Pacific has taken the lead.

This company has recently made another advance by placing in service ten 4-8-2 type locomotives to haul their heavy passenger trains between Los Angeles, Cal., and El Paso, Tex. These locomotives were especially designed for this long run over that difficult mountain and desert territory, a distance of 815 miles, which is made without changing locomotives, thus establishing a new record for long locomotive runs. It is anticipated that these locomotives will average about 12,000 miles per month.

The general design and specifications for these locomotives were worked up under the supervision of George McCormick, general superintendent motive power, and Frank E. Russell, assistant mechanical engineer, the design being completed and details worked out with the American Locomotive Company which built the locomotives. The outstanding characteristics sought in this design were maximum tractive power within the weight limits and ample boiler capacity for the long sustained runs. This required refinement in design to provide ample strength with minimum weight necessitated the use of materials of high tensile strength for many parts.

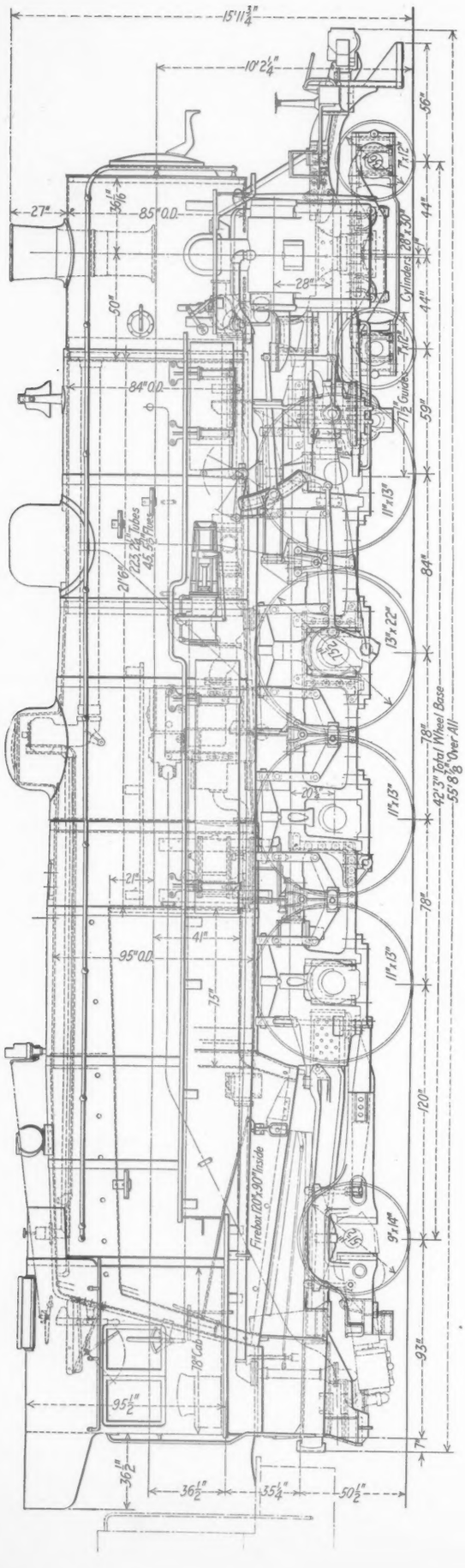
The character of the territory over which these locomotives are operating is shown on the accompanying profile. Grades of 2 per cent occur from Colton to Beaumont going east and from Indio to Beaumont going west. Also, from Tucson to Dragoon going east there are grades of 1.5 per cent. Previously the through passenger trains were hauled over the districts which have the heaviest grade by 2-8-2 type locomotives, and by 4-6-0 type locomotives and 4-6-2 type locomotives where the grades are lighter. With trains varying from 8 to 12 cars, the time card calls for schedules for Sunset Limited trains of 24.2 miles per hour from Colton to Beaumont and of 26.2 miles per hour from Indio to Beaumont. From Tucson to Dragoon the schedule is about 30 miles per hour. Most of the remaining portions of the line consist of grades of approximately one per cent, the schedules varying from 38 to 42 miles per hour. It is expected that the new 4-8-2 type locomotives, which have a high sustained steaming capacity, will bring the maximum and minimum operating speeds nearer to the average, which will materially reduce the maintenance costs of both locomotives and track.

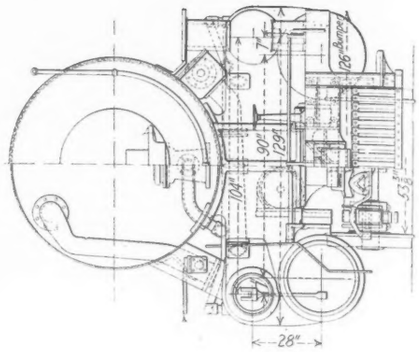


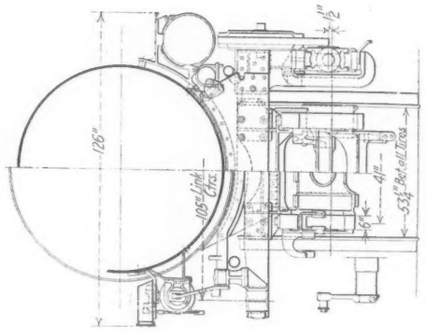
Profile of the Southern Pacific Between Los Angeles and El Paso, Where the Run of 815 Miles Is Made

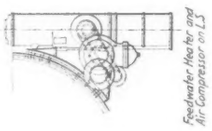
These 4-8-2 type locomotives have a total weight of 368,000 lb., of which 246,000 lb. are on the drivers. The maximum tractive force is 67,660 lb. with the booster, and 57,510 lb. without the booster, the ratio of adhesion for the drivers being 4.28. Using Cole's ratios as a basis of comparison, they have a maximum cylinder horsepower capacity of 2,965 and a boiler capacity of 103.4 per cent, including the increase obtained by the use of the feedwater heater. This high percentage of boiler capacity indicates that it can supply the cylinders at high speeds without forc-

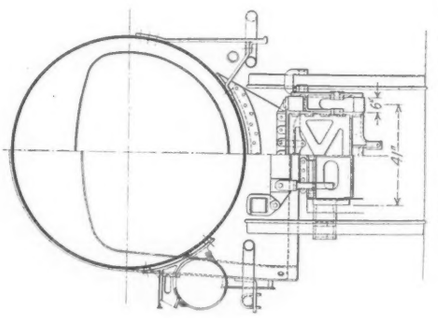
*For a description of these locomotives see *Railway Mechanical Engineer*, August, 1921, page 481.

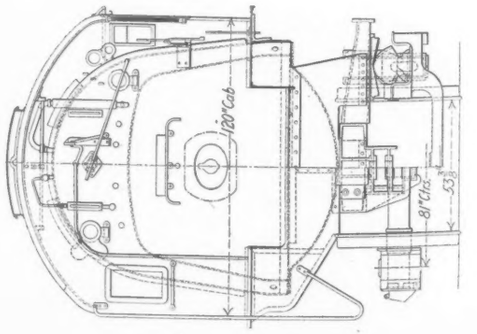












Elevation and Cross Sections of the Southern Pacific 4-8-2 Type Locomotive

ing. The boiler was designed with the largest proportions possible to obtain ample steaming capacity and, at the same time, to keep the wheel load on the track within safe limits.

Boiler and Smoke Stack

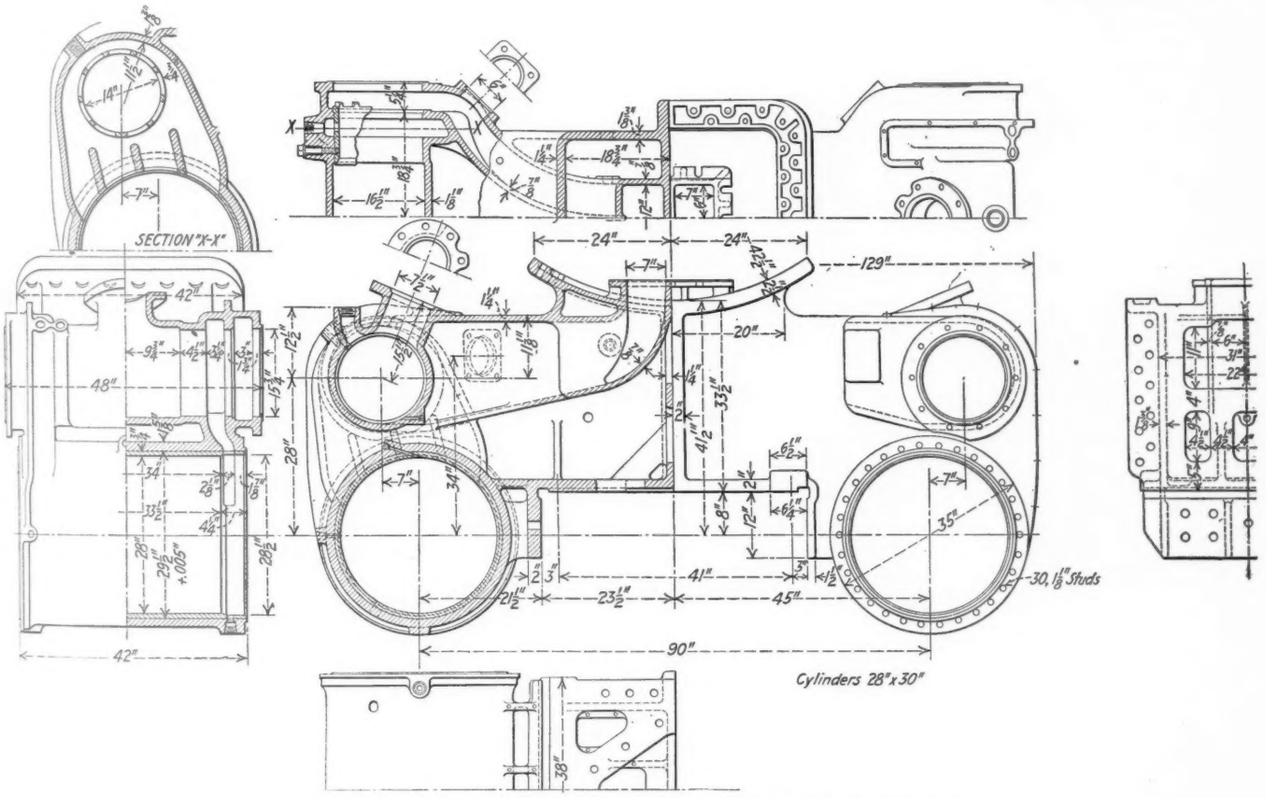
The boiler is conical in form with an inside diameter of 82 7/16 in. at the front barrel course, increasing to 93¾ in. at the combustion chamber course. The firebox measures 121 1/16 in. by 90 in. inside of sheets at the mud-ring and includes a combustion chamber 75 in. in length, which provides for tubes 21 ft. 6 in. long. The steam space above the crown sheet is 30 in. at the back end and 25¼ in. at the front end. The Type A superheater consists of 45 units with a superheating surface of 1,162 sq. ft. The boiler shell is of 25/32 in. material for the first course and ⅞ in. for the second and third courses; and the wrapper sheet is ½ in. thick. The firebox and combustion chamber sheets are ⅜ in. excepting the inside throat connection which is 9/16 in. thick and welded in between the side sheets and the combustion chamber. The firebox is fitted with F. B. C. welded universal sleeves and reduced body staybolts.

The smokestack is a new design of the railroad company. It consists of four iron castings, assembled in such a manner that the extension of the stack in the smokebox can be easily and quickly removed. The castings forming the extension, which are most subject to wear, can be replaced by new castings with very little trouble and without disturbing the alinement of smokestack and base. The casting forming the lower portion of the extension is so designed that the height of the bell above the exhaust nozzle may be increased or decreased to give the best draft conditions. This feature also makes the stack applicable to a number of other types of locomotives.

Cylinders and Running Gear

The cylinders follow the American Locomotive Company's light design, except that the exhaust passages have been enlarged considerably above those which are in general use. The size of the opening at the top of the saddle is 12 in. by 7 in., providing unrestricted exhaust passages up to the exhaust nozzle. The exhaust stand is secured by twelve 1⅛-in. tee-head bolts. The exhaust passages of the cylinders are extended 4 in. above the cylinder saddle and provided with a 1⅛-in. flange, well reinforced with ribs, extending down to and joining the cylinder saddle. This construction eliminates troubles experienced in maintaining a tight joint, the absence of which interferes with the draft of the locomotive. The cylinders provide for outside steam pipes and connections for superheated steam to the Franklin Railway Supply Company's Type C-1 booster and exhaust steam to the feedwater heater. The depth of the casting over the frame section gives a very strong construction with the minimum of weight.

The steam distribution is controlled by 14 in. piston valves having a maximum valve travel of 7 in., a constant lead of ¼ in., a steam lap of 1¼ in. and an exhaust clearance of 3/16 in. The piston valves are propelled by a direct Walschaert gear, adjusted to give equal cut-off at 55 per cent stroke. The valve gear is controlled by an Alco power reverse gear.

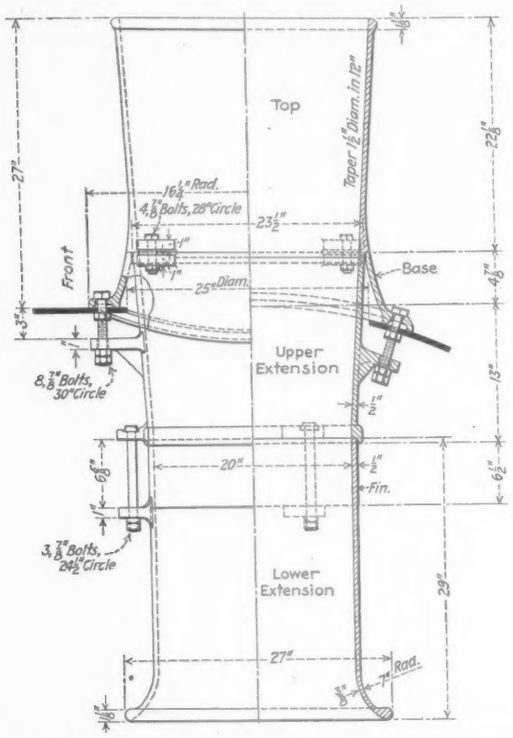


28-In. by 30-In. Cylinders for the Southern Pacific 4-8-2 Type Locomotive

The frames, as well as all other castings subjected to heavy stresses, are made of high grade cast steel, thus permitting considerable reduction in weight. The main frames are of the two-bar type, 6 in. wide, the depth of top rail over jaws being 7¼ in. for first and main drivers and 6¾ in. for third and fourth drivers. The frames at the cylinder fit are of the single-bar type of slab section, and provision was made for ample bolting and large keys. They are unusually well braced throughout. The driver brake cylinders are secured to the main frames just back of the steam cylinders and placed in a horizontal position, thus relieving the frames of unnecessary stresses due to braking. The rear section is a Commonwealth Steel Company's cradle casting, the front end of which is so designed that the trailing truck can be dropped down

without moving the truck back. This facilitates making repairs to the booster.

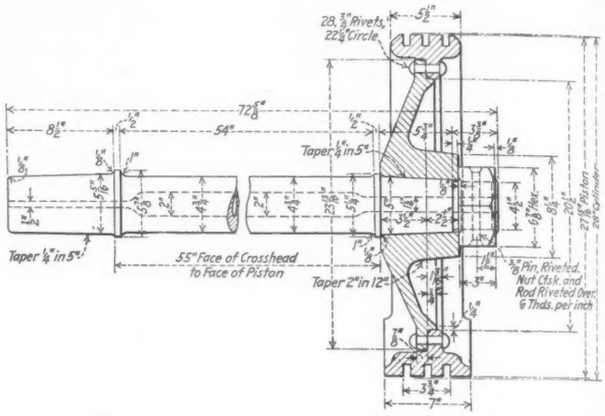
The journal bearings throughout are unusually large, especially the main, which is 13 in. in diameter by 22 in. long. The frame brace crossties forming the extended



The Four Piece Stack Facilitates Renewals and Adjustments for Draft

pedestals for the main driving boxes are of high grade cast steel and, in addition to being well secured to the frame pedestals, are tied together, top and bottom, by supplementary pedestal binders, which add much to the rigidity of the pedestals and prevent journal bearings and axles from wearing conical.

It is interesting to note that the spring rigging has been constructed to incorporate bent equalizers similar to those used on the Southern Pacific 2-8-0 type locomotives, which were placed in service some 20 years ago. This is design of equalizer provides a more stable construction by keeping the spring rigging lined up, particularly on 4-8-2 type locomotives. On lighter power this type of equalizer is not so essential and the advantage of its use has for some time been practically overlooked. The Southern Pacific has again brought this design into use by installing the bent equalizers on their 4-8-2 type locomotives, which will obviate the trouble ordinarily experienced with the spring rigging on this type of locomotive.

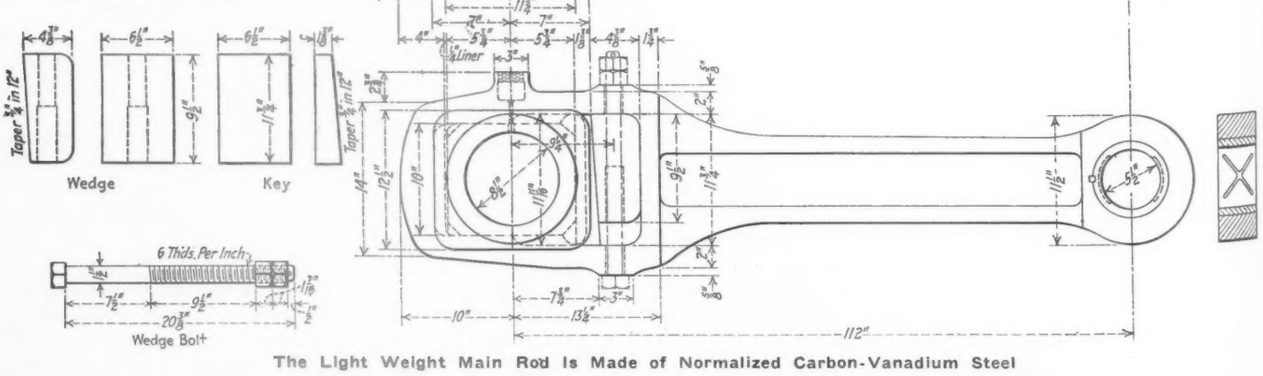

28 3/8" Rivets, 22¾" Circle
72 5/8"
54"
Taper 1/4" in 5"
Taper 1/4" in 5"
55" Face of Crosshead to Face of Piston
Taper 2" in 12"
3/8 Pin, Riveted, Nut Ctsk. and Rod Riveted Over 6 Thds. per inch
7"

Hollow Piston Rod and Built-Up Z-Type Piston Reduce the Weight

Careful Design Reduces Weights and Dynamic Augment

One of the outstanding features in the design of this locomotive is what has been accomplished in obtaining increased tractive force without increasing the stresses set up in the track and roadbed. To accomplish this, the engine is equipped with a constant-resistance centering device. Also, the forward pair of drivers is fitted with the Franklin lateral motion device, thus making ample provision for the engines to take curves with a minimum stress in the track. These centering devices also hold the engine steady on a tangent track, reducing to a minimum the lateral movement due to the steam action.

In order to keep down the dynamic augment to a minimum, the engine is equipped with connecting rods of normalized carbon-vanadium steel of I-section, hollow piston rods and Z-type pistons, thus providing light reciprocating parts, 50



The Light Weight Main Rod Is Made of Normalized Carbon-Vanadium Steel

per cent of which are balanced. The total weight of the reciprocating parts is 1,830 lb., or one pound to each 201 lb. of the total weight of the locomotive in working order as compared with the ratio of 1 to 160, which is generally considered good practice.

The following tabulation shows a comparison of the weights of the reciprocating and revolving parts for the 4-8-2 type locomotives with the weights of similar parts for the 2-8-2 and 4-6-0 types which the new locomotives displaced. This is interesting in that it shows that by refinement in design and the use of higher grade material a much more powerful and heavier locomotive has been built without increasing the disturbing forces in track.

WEIGHTS OF RECIPROCATING AND REVOLVING PARTS

	4-6-0	2-8-2	4-8-2
Cylinders, diameter and stroke	23 in.x28 in.	26 in.x28 in.	28 in.x30 in.
Driving wheels, diameter	69 in.	63 in.	73 in.
Boiler pressure	210 lb.	200 lb.	210 lb.
Tractive force	38,320 lb.	51,080 lb.	67,660 lb.
Piston and rod complete	597 lb.	685 lb.	794 lb.
Crosshead and pin complete	449 lb.	475 lb.	640 lb.
Total weight of main rod	861 lb.	1,006 lb.	1,217 lb.
Total weight of parallel rods	966 lb.	1,371 lb.	1,253 lb.
Total weight of reciprocating parts	1,518 lb.	1,691 lb.	1,830 lb.
Ratio, reciprocating parts to total weight of locomotive	1/144	1/166	1/201

POUNDS WHEEL PRESSURE ON RAIL

4-6-0 Locomotive	1st	2nd	3rd	4th
Dynamic augment at 63 m. p. h.	10,425	12,025	11,170	.....
Static wheel load	29,950	31,400	25,600	.....
Total wheel pressure	40,375	43,425	36,770	.....
2-8-2 Locomotive				
Dynamic augment at 63 m. p. h.	11,334	11,558	11,334	11,334
Static wheel load	25,650	26,200	27,000	26,000
Total wheel pressure	36,984	37,758	38,334	37,334
4-8-2 Locomotive				
Dynamic augment at 63 m. p. h.	8,075	8,435	8,110	8,110
Static wheel load	30,800	30,550	30,750	30,900
Total wheel pressure	38,875	39,985	38,860	39,010

Special materials were used in parts subjected to heavy stresses as follows:

QUENCHED AND TEMPERED STEEL

Tensile strength 85,000 lb. per sq. in.

Crank pins — Driving axles
Main crank pins, hollow bored — Engine truck axles
Piston rods, hollow bored — Trailing truck axles

NORMALIZED CARBON-VANADIUM STEEL

Tensile strength 90,000 lb. per sq. in.

Main and side rods

SPECIAL GRADE CAST STEEL

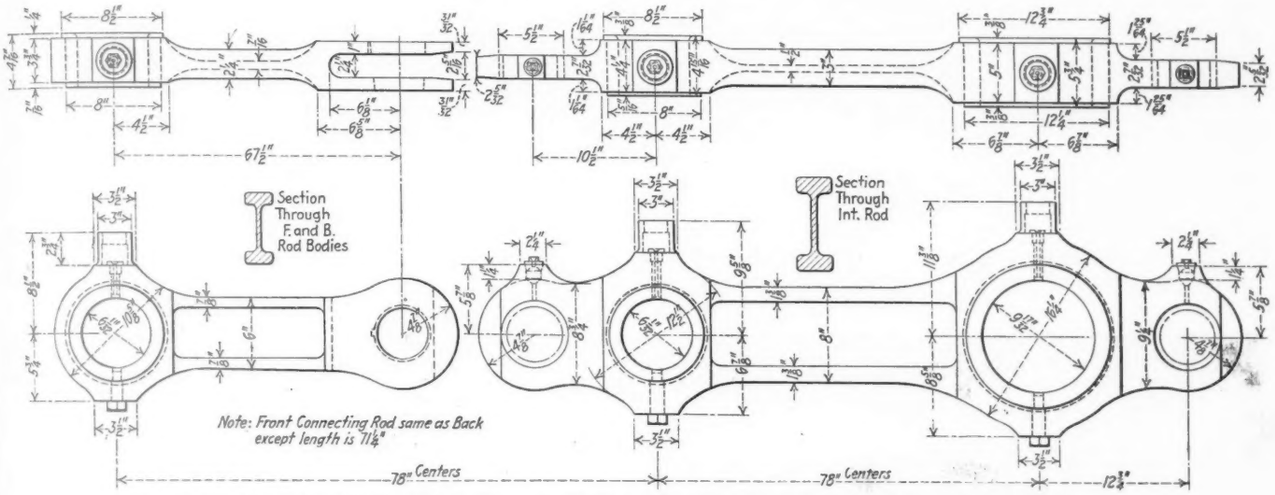
Tensile strength 75,000 lb. per sq. in.

Main frames — Lateral motion driving box, spacer and rocker
Frame crossties — Engine truck swing frame, etc.
Frame filling castings — Driving spring stirrups
Driving and trailing wheel centers — Guide yokes
Driving and trailing boxes — Spring saddles
Pedestal caps — Reverse shaft bearings
Pistons — Link supports and checks
Cylinder heads — Bumper bracket
Back steam chest heads — Engine truck center plate
Crossheads

Special Equipment and Details

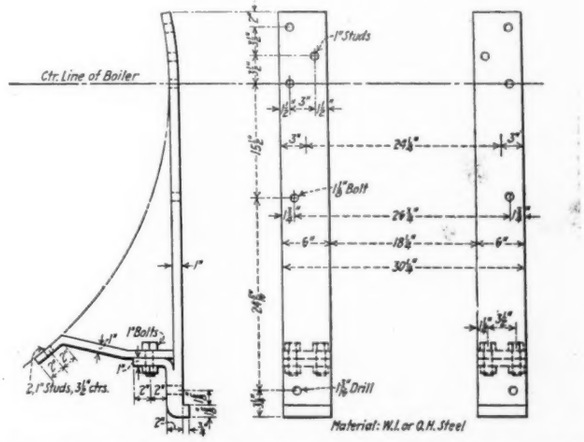
The Westinghouse No. 6 ET brake equipment is applied, the air being supplied by one 8½-in. cross-compound compressor. The application of brakes to the trailing truck wheels brings the braking power of these locomotives up to the maximum, since this results in all the wheels of the locomotive being equipped with brakes. Clasp brakes are used on the tender truck wheels.

The supports for the air compressor and the feedwater heater are of wrought iron construction, and have been developed by the Southern Pacific to overcome the trouble experienced with the old design of cast steel supports working loose on the boiler. That for the air compressor is illustrated; that for the feedwater heater is of similar design.


Section Through F. and B. Rod Bodies
Section Through Int. Rod
Note: Front Connecting Rod same as Back except length is 71¼"
78" Centers
78" Centers

Normalized Carbon-Vanadium Steel of 90,000 lb. Tensile Strength Is Used for the Side Rods

A flange lubricator is applied, which provides lubrication for the flanges of the front driving wheels. The oil reservoir is located on the left side of the smokebox, where the crude oil used is sufficiently heated to run through piping leading to the front driving wheel flanges, the flow being regulated by needle valves. Flange oilers are also applied to the trailing wheels.



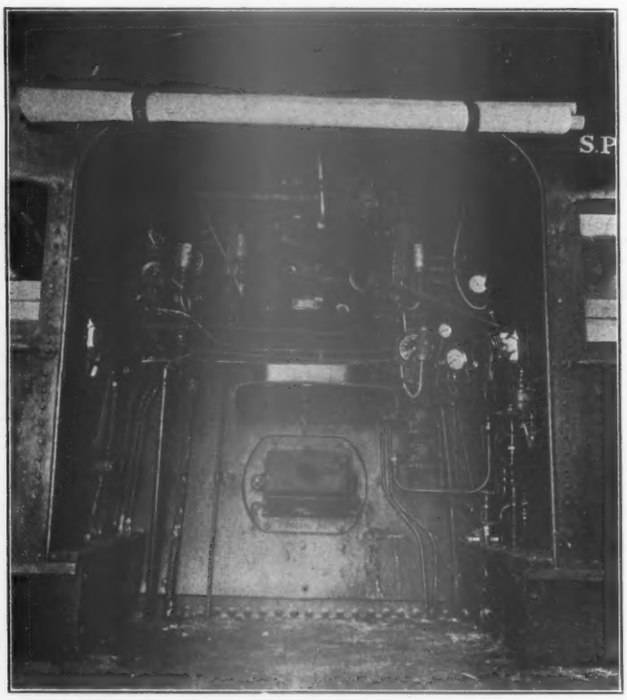
Light, Yet Rigid Forged Bracket for 8½-In. Cross Compound Air Compressor

The feedwater is supplied by one Worthington combined feedwater heater and a pump of 7,200 gal. capacity per hour, placed on the left side and by one Nathan non-lifting injector, placed on the right side, the latter being used only in cases of emergency and when the locomotive is not working.

Another source of reduction in weight without sacrificing

strength is in the application of a shorter and somewhat narrower cab. By placing the steam turret on the outside of the cab at front, it was possible to make a material reduction in the length of the cab. By eliminating the two doors at the front, which with large size boilers have, of necessity, always been made so narrow as to be very impractical, the width of cab has also been decreased. However, a window at the front on each side has been applied. The saving in weight on account of the application of the smaller cab amounts to about 200 lb. To take the place of cab doors, the steel floor of the cab has been extended 5 in. out beyond each side of the cab to be used as a running board and handholds have been conveniently located near the eaves to enable enginemen to pass around outside of the cab to and from the running boards at front. This extra width of cab floor dispenses with the use of supplementary running boards, located just below the cab floor, which is the practice on many roads for large power. A further saving of 300 lb. is thus effected. Moreover, for convenience of the engineman, the blow-off cocks are operated by means of two levers located in the cab, one on each side.

Special attention has been given to the arrangement of cab fixtures and operating levers, as the satisfactory and economical operation of powerful locomotives depends upon



The Cab Is Short, Compact and Well Arranged

the convenient location of gages and controlling devices. Extension handles are applied to all valves on the top of the boiler head in inaccessible places, and arranged in convenient locations. They are supported by a wrought iron bracket secured to the roof of the cab, the bracket carrying an aluminum name plate having the name of each control handle stamped in ¾-in. letters. These letters are filled with black paint and the surface of the plate is polished.

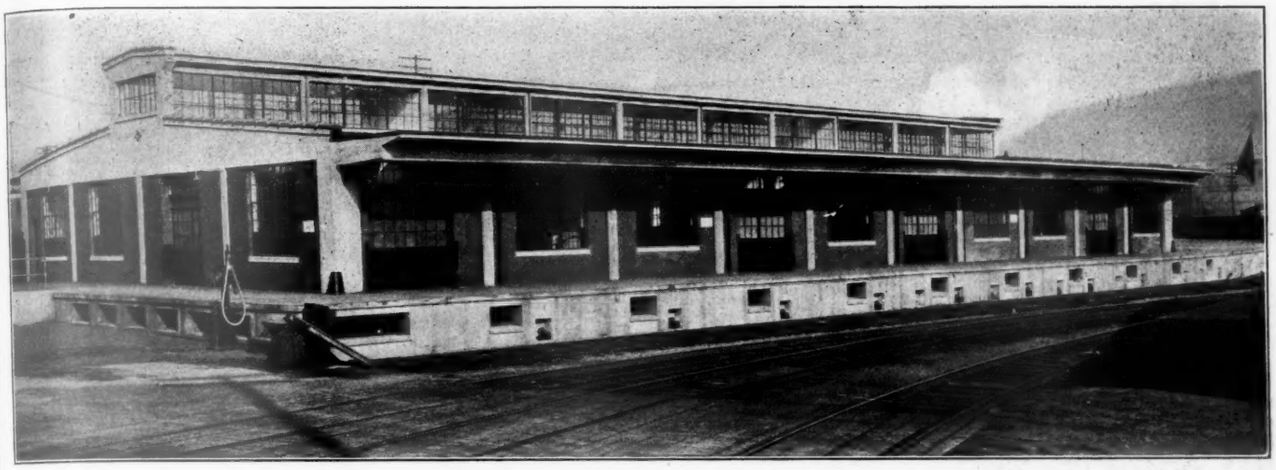
The tender is of the Vanderbilt type, carrying 4,000 gal. of oil and 12,000 gal. of water. The tank is carried on a Commonwealth cast steel frame, made in one piece with the bumpers and the transverse bolsters, which serve as tank supports. The four-wheel trucks are of the Commonwealth design, with cast steel frames and swing bolsters. This is an equalized pedestal type of truck, fitted with both helical and triple elliptic springs. Side bearings are used on the rear truck only.

The principal dimensions, weights and proportions of these locomotives are given in the accompanying table.

Railroad	Southern Pacific
Builder	American Loco. Co.
Type of locomotive	4-8-2
Service	Passenger
Cylinders, diameter and stroke	28 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1¼ in.
Exhaust clearance	1/16 in.
Lead in full gear, constant	¼ in.
Weights in working order:	
On drivers	246,000 lb.
On front truck	61,500 lb.
On trailing truck	60,500 lb.
Total engine	368,000 lb.
Tender	226,900 lb.
Wheel bases:	
Driving	20 ft. 0 in.
Rigid	13 ft. 0 in.
Total engine	42 ft. 3 in.
Total engine and tender	83 ft. 6 in.
Wheels, diameter outside tires:	
Driving	73 in.
Front truck	36 in.
Trailing truck	51 in.
Journals, diameter and length:	
Driving, main	13 in. by 22 in.
Driving, others	11 in. by 13 in.
Front truck	7 in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Conical
Steam pressure	210 lb.
Fuel, kind	Oil
Diameter, first ring, inside	82 7/16 in.
Firebox, length and width	121 1/16 in. by 90 in.
Height mud ring to crown sheet, back	65½ in.
Height mud ring to crown sheet, front	90½ in.
Combustion chamber length	75 in.
Tubes, number and diameter	223—2¼ in.
Flues, number and diameter	45—5½ in.
Length over tube sheets	21 ft. 6 in.
Grate area	75.7 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	350 sq. ft.
Tubes	2,813 sq. ft.
Flues	1,388 sq. ft.
Total evaporative	4,551 sq. ft.
Superheating	1,162 sq. ft.
Comb. evaporative and superheating	5,713 sq. ft.
Tender:	
Style	Vanderbilt
Water capacity	12,000 gal.
Fuel oil capacity	4,000 gal.
Trucks	4-wheel
General data estimated:	
Rated tractive force, 85 per cent	57,510 lb.
Rated tractive force with Booster	67,660 lb.
Cylinder horsepower (Cole)	2,965
Boiler horsepower (Cole) (est.)	3,067
Speed at 1,000 ft. piston speed	43.4 m.p.h.
Steam required per hour	61,672 lb.
Boiler evaporative capacity per hour	57,014 lb.
Feed water heater, equiv. evap. capacity per hr.	6,784 lb.
Total evap. capacity per hr.	63,798 lb.
Weight proportions:	
Weight on drivers ÷ total weight, per cent	66.8
Weight on drivers ÷ tractive force	4.28
Total weight engine ÷ cylinder hp.	124.0
Total weight engine ÷ boiler hp.	120.0
Total weight engine ÷ comb. heat. surface	64.4
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	103.4
Comb. heat surface ÷ cylinder hp.	1.93
Tractive force ÷ comb. heat. surface	10.07
Tractive force × dia. drivers ÷ comb. heat. surface	736
Cylinder hp. ÷ grate area	39.2
Firebox heat. surface ÷ grate area	4.63
Firebox hea. surface, per cent of evap. heat. surface	7.69
Superheat. surface, per cent of evap. heat. surface	25.53

A "LIFE TABLE" recently prepared by the statistical division of the Metropolitan Life Insurance Company from figures compiled by the Locomotive Engineers' Mutual Life and Accident Insurance Association, shows that the average locomotive engineer of 28 may count on living until he reaches the age of 69. Despite the hazards of the engineer's calling, insurance figures show a substantial decline in mortality among men in that occupation during the past 10 years. Between the ages of 31 and 55, the declines ranged from 32 to 44 per cent. Beyond the age of 55, the figures varied, but this reflected the small number exposed to risk.

A decline in the accident death rate from 318 per 100,000 in 1912, to 167 per 100,000 in 1922, shows the great improvement in safety provisions for the operating personnel of American railroads and accounts for a large part of the saving in mortality at the age range from 31 to 55 years.



The New Reading Company Oil House at Reading, Pa. The Storage Tank Filling Connections Are Shown in Recesses Under the Platform

The Reading Builds Model Oil Storehouse

Fireproof Structure, Well Lighted and Ventilated, Completely Equipped with Modern Facilities

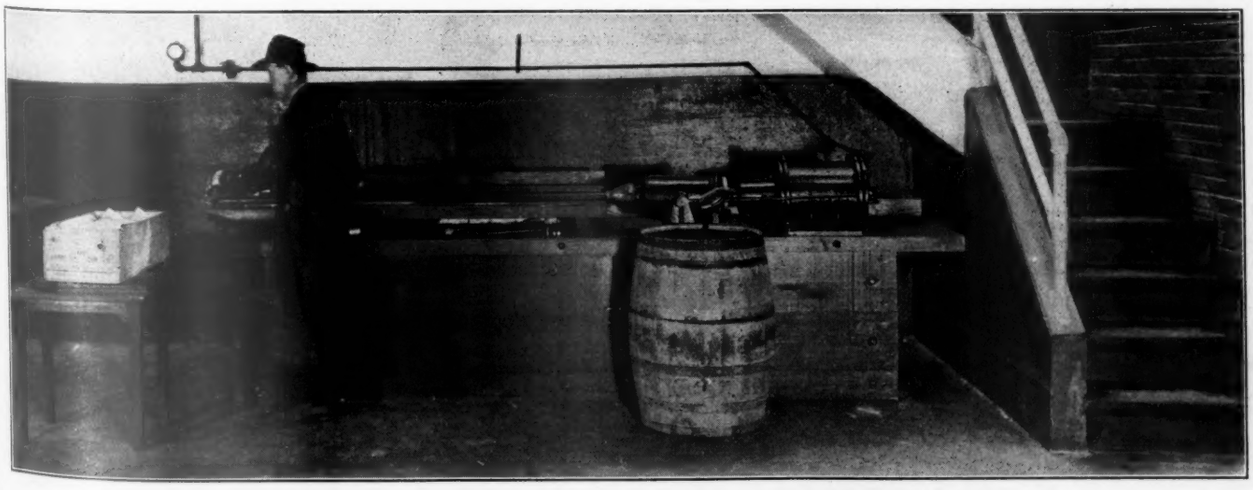
ONE of the most modern and completely equipped oil storehouses in America has just been completed and put in operation by the Reading Company at Reading, Pa. The building is constructed of reinforced concrete, steel and brick, making it entirely fireproof. It is 75 ft. wide by 150 ft. long and contains one story and a basement. A platform 3 ft. 9 in. above the top of the rail with a total area of 6,624 sq ft., adjoins the building on one side and the two ends. On the west end and south side of the building it is 10 ft. wide. At the rear, or east end, it is triangular in shape, tapering from a width of 80 ft. at the building to 16 ft. wide at the extreme end, 138 ft. from the building. This end platform is used for storing empty barrels and is laid out with 2-in. painted lines, into spaces which are stenciled to designate the kinds of barrels to be placed in them. A ramp leads from the ground on the west end of the building to the platform, for the use of electric trucks.

The loading and unloading track on the south side of the building will hold seven cars. The storage tank filling connections are located in recesses under the platform.

The basement extends out beneath the front and west end platforms and is 85 ft. wide by 160 ft. long. A room along the south side, adjoining the unloading track, 40 ft. wide by 155 ft. long and 13 ft. high in the clear, accommodates 12 large rectangular tanks with a capacity of from 10,000 gallons to 16,000 gallons each. A 10-hp. motor is provided to operate an agitator. An open duct and drain, 5 ft. wide by 2 ft. 6 in. deep, runs the full length of the building just back of the tanks. In addition to providing for drainage and pipe lines, it is also equipped with a narrow gage track on which is operated a steel car with a tank, which may be placed opposite any of the tanks when cleaning them out. Concrete pillars, 12 in. above the level of the floor, provide sufficient place under the tanks for steam radiators and pipe lines. The oil from cars runs into storage tanks by gravity.

The north half of the basement has a clear height of 9 ft. and is divided into five rooms. The east room, containing 24 tanks ranging in capacity from 120 gallons up to 1,500 gallons, is 41 ft. by 43 ft. Four agitators operated by a 5-hp. motor are provided on four of the tanks. An oil filter is also located in this room.

Adjoining this room on the west is a barrel room, 34 ft.



One Room in the Basement Is Used for Molding and Storing Rod Cup Grease

The Barrel Storage Room—Light and Ventilation Are Provided by the Clerestory

by 73 ft. with entrance from the main floor above by stairway and electric elevator. The elevator has a capacity of 4,000 lb. and is used in hoisting the barrels to and from the main floor. A small space, 15 ft. square, in this room is provided with a compounding tank 4 ft. 6 in. wide by 8 ft. long by 3 ft. deep, for use in manufacturing soft soap, disinfectant and car cleanser.

The room next adjoining measures 14 ft. by 34 ft. and is used for cleaning and storing cans. The room at the west end of the basement is 23 ft. wide by 34 ft. long. Here rod cup grease is molded and stored for use. A stairway leading from this room to the platform on the outside of the building has been provided in order to avoid going through to the other end of the building to reach the first floor from this room.

On the east end of the main floor, adjoining the barrel storage platform, a room 43 ft. wide by 74 ft. long, contains 24 hand pumps of five gallons capacity each, with two extra or emergency hand pumps of the same capacity; five power pumps, each with a capacity of 40 gallons per minute, and one extra or emergency power pump; one 6,000-lb. capacity scale for general use, and one 12,000 lb. capacity scale under the compounding oil tank, which is 6 ft. 1 in. wide by 7 ft. 7 in. long and 3 ft. 9 in. deep. This room also contains four journal packing tanks 8 ft. 4 in. by 8 ft. 4 in. by 2 ft. 9 in. deep, three of which are used for freight car and one for coach packing. Outside of this room under the concrete platform are located two circular tanks of 10,500 gallons capacity, each, both containing engine gasoline, and one of 500 gallons capacity with 88 deg. gasoline.

The center room, used for barrel storage, is 72 ft. wide by 73 ft. long, with a 12-ft. by 12-ft. space for toilets and wash bowls. This room also contains the 10-ft. by 10-ft. enclosed electric elevator shaft. The floor of this room is marked off with two-inch white lines, with proper stenciling, into spaces reserved for the various classes and grades of oil that are stored in barrels.

A 28-ft. by 66-ft. room at the west end of the building is separated by a fire wall from the adjoining barrel room. This is used for the storage of waste.

The Pump Room at the East End of the Building; Journal Box Packing Tanks at the Left

Along the driveway at the west end of the building, a 500-gallon gasoline tank with an outside pump is provided for the use of the company's motor trucks.

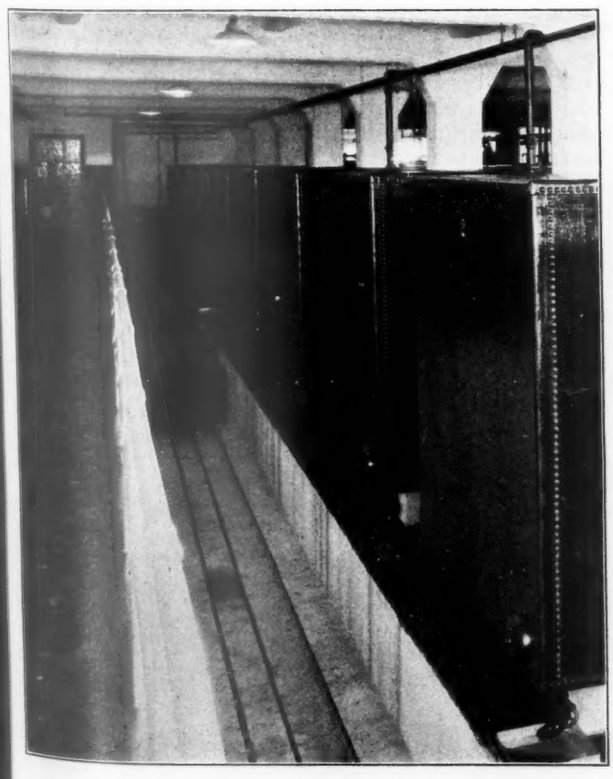
A commodious skylight extends the full length of the building, providing ample light and ventilation. The building is equipped throughout with electric lights and with steam, water and air lines, all of which are painted in distinguishing colors.

Motor-Driven Agitators Are Provided in Four Tanks

It is anticipated that, with this modern building and its facilities, the stores department will eliminate leakage and tank waste and at the same time insure to users good clean oil with a maximum service at a minimum cost. It will also facilitate the release of tank cars more promptly. A tank car of heavy oil can be unloaded in a few hours and a tank car of kerosene in less than an hour, enabling the oils to be unloaded in the morning, a shift made and the cars placed for shipment before noon. In filling or drawing there is no waste of oil, the drip from the pumps going back into the tanks. The filling of barrels is accomplished rapidly, with an exact check on the amount required and shipped. This will assist in avoiding differences in the oil accounts.

All oil tanks	Black
All oil pumps (including power pumps)	Olive green enamel
All oil filling lines and drip return lines	Black
All oil tank vent lines	Black
All oil suction lines	Red
All oil pump delivery lines in basement and pump room	White
Outside gasoline pump	Red enamel
Compressed air lines	Bright green
Water lines	Yellow
Steam radiators and piping	Navy gray

Plans for the building were drawn and the construction carried out under the supervision of S. T. Wagner, chief engineer of the Reading Company. The equipment layout and installation of steam, water and air lines was under the direction of C. A. Bingaman, mechanical engineer. The contractor was Robert E. Lamp & Company, Philadelphia, Pa. The equipment, consisting of the tanks, pumps, etc., was furnished and installed by the Tokheim Oil Tank & Pump Company, Fort Wayne, Ind.



The Storage Tanks Are Located in the Basement

The Superheater—Its Abuse as a Fuel Saver*

By Bard Browne

Service Engineer, The Superheater Company

WITH over 40,000 superheated steam locomotives operating in this country alone, it is not necessary for me to impress you with the superheater's importance as a locomotive appliance. Each one of you was once sold on the idea of the superheater, either by the Superheater Company or by one of your colleagues and many of you induced your companies to spend the necessary money for superheater applications. All of you, I dare say, carry, safely tucked away in your consciousness the conviction that, since you ordered a properly proportioned superheater and applied it to your locomotive in accordance with our advice, you are obtaining an average fuel saving of 25 per cent and an average water saving of 35 per cent. In the rush of your affairs you feel secure as to the superheater as a fuel saver.

On the other hand, we who make a continual study of the subject see, from time to time, evidence of tendencies to take too many things for granted, of an inclination to sit back and let the superheater live up to its reputation.

Superheated steam is over-heated saturated steam. If we put additional heat, or what is the same, additional energy into a pound of saturated steam, we can naturally get more out of it when this steam does expansive work. The more additional heat we put in, *i.e.*, the more we superheat the saturated steam, the more additional work we can gain. That part is quite comparable with putting more or less energy into the steam by generating it with more or less pressure. The important point is that to think of superheated steam without a statement of the amount of superheat, is just as indefinite as to think of saturated steam without a statement of its pressure.

The steam enters the superheater always at the tempera-

*Abstract of a paper presented at the convention of the International Railway Fuel Association, at Cleveland, Ohio, May 21-24, 1923.

ture corresponding to boiler pressure, but the temperature of the heating gases, and therefore the temperature difference between the gases and the steam, depends upon a good many factors. It is principally this difference in temperature between gas and steam which determines the capacity of the superheater, or the amount by which the steam can be overheated. We must keep in mind that the superheater capacity, after the size and number of units has once been fixed, cannot be adjusted at will, but is entirely determined by boiler and grate performance. It is entirely dependent on the fixed amount of unit length and upon the fixed location of the superheater tubes with relation to the flues; in other words, upon the amount and disposition of the superheater heating surface, and, furthermore, upon the condition of the steam within the superheater and the gases outside the superheater. The steam and gas conditions can be precalculated for normal boiler performance, but naturally not for departures from normal.

In previous papers and reports submitted to this association, we have been sufficiently cautioned against abnormal boiler and grate performance as endangering superheater capacity. Thus the question of carrying an undue amount of water over into the superheater tubes, which water must be evaporated and thus absorbs heat lost for superheating, has been agitated. Other conditions affecting superheater capacity, such as coated or stopped-up flues and tubes, imperfect combustion and low firebox temperatures on account of incorrect firing, have been amply discussed.

One phase of the subject which has, however, not been sufficiently emphasized in the past, is interference of superheater capacity by improper or negligent superheater maintenance. Superheater unit tubes naturally see very hard service, harder than is commonly appreciated. Partially or highly superheated steam is a very poor conductor of heat, and therefore the metal of the tube in contact with such steam is at a very much higher temperature than the metal of the boiler tubes, which is cooled by water. Then, further, the steam and metal temperatures constantly fluctuate in the working of the engine, whereas the metal of the boiler tubes does not change its temperature so much, because the water is always at the same temperature as long as the pressure does not fluctuate unduly. These changes in metal temperature in the superheater cause differential expansion strains, which again lead to crystallization and ultimate failure, mostly at the points where the greatest mechanical strain occurs, directly under the ball joint, and where the greatest heat strain occurs, at the back return bends.

When the railroads began to patronize our reclaiming department, where we re-condition failed units, and sent to us carloads of units, we had quite a revelation. We saw to what an extent it had been necessary to make emergency repairs to units, evidently in order to keep from tying up engines in the face of an insufficient stock of spare units, and that many of the emergency repairs seriously interfered with the capacity of the superheater. Many units were unduly shortened, probably because the metal of the tube was burned over quite a distance from the back return bend. Many had been repaired by autogenous welding with such a plentiful use of welding metal that either internal free area for the steam flow, or the external area for the flow of gases was appreciably restricted. Some units had the original back return bends removed and home-made structures of the crudest design and strength substituted, with the most appalling restrictions.

It is quite evident that whoever made or authorized these emergency repairs did not realize how finely the length, location and cross-section of super-heater units and flues were calculated by the designer, and how much departure from the original design affects superheater capacity and fuel saving. Units must be maintained of about the length fixed by the original design. In reclaiming units we do not allow more than six inches reduction of original length. The internal steam area through the unit pipe must not be obstructed by injudicious bending or improperly made butt-welds, because the resultant pressure drop means loss of capacity, longer cut-offs for a certain power output, and lower cylinder efficiencies, with a corresponding reduction in the available fuel economy.

Net gas areas around the units must be maintained as originally calculated, because we are working in the combination of superheater and boiler, with a definite draft balance between the superheater flues and small tubes; the maintenance of that balance is imperative for the maintenance of the superheater performances originally contemplated. The introduction of forged return bends in place of cast steel return bends is not only an improvement in mechanical jointing, but the forged return bends present less obstruction to the gases flowing through the flues than did the cast steel return bends. Obstruction at the back end of the flue, where the gases have a high velocity due to their high specific volume, is serious.

You may say that an occasional unit improperly repaired will not upset the superheater performance appreciably. Probably not, but if you let the bars down, where is the improper practice going to stop? I urge, then, that you do not consider or allow those associated with you to consider the superheater as a bundle of pipes placed in the boiler at random, but a carefully proportioned heat exchanger which must be properly maintained if it is not to lose capacity, or your companies to lose a part of the fuel saving which you originally obtained.

Safety as a Builder of Morale*

By F. W. Mitchell

Director of Personnel, New York, New Haven & Hartford

No mechanism that functions in the production of transportation is as complex in its makeup as are the human beings to whom its operations are committed. And although the human element is susceptible to great changes, by means of education and training, it can hardly be argued that the same effort has been given to railroad "humanics" that has gone into the development of the mechanical resources. It would be difficult to describe just how we should proceed, in order to attempt in this field the accomplishment that is apparent in the mechanical. Some things, however, are evident, and among these we find first that there should be greater care used in selecting our human material, investigating the references presented and the conditions which surrounded the new employee before taking him into the organization.

For a number of years the railroads have been carrying on safety work. The benefits derived from this effort have been far in excess of the cost of the work. It is not too much to say that the entrance into the larger field, and the expanding activities which are directed toward the development of morale have resulted in a measure from the evident effects of the safety work in this direction.

There was unquestionably a time in the history of our American railroads when the voice of the public was calling loudly for speed in annihilating distance together with reliability in maintaining schedules. The effect of this strong sentiment was to increase, in no small degree, not only the number of "chance takers" in train operation, but also the extent of the risks that they were willing to take. Operating officers noted their violations of rules and instructions when conspicuous consequences compelled recognition. Investigations of accidents revealed such information only as it was

*From an address at the meeting of the Steam Railroad Section of the National Safety Council, held at Buffalo, N. Y., October 2, 3 and 4, 1923.

impossible to conceal. A spirit of competition and rivalry tended to further aggravate the dangerous situation. Cautionary measures were set aside by the employee if so he might thereby execute some stunt which, if successful, might mark his exceptional ability. There was a wide separation in the theory and practice of safe operation. Confidence was weakened; morale reduced. That which should have been an army of organized workers for safety was becoming a mob of "go as you please as long as you're lucky" buccaneers.

Even the grounds for promotion were becoming more and more based upon the element of "luck," and the "good guesser" could ride the top wave of popularity. Safety was becoming an artificial veneer.

When Morale Appears

But there was a penalty to all this and from time to time it presented stern demands. It became evident that something was going very wrong and that a change was required not only in methods but in the appraisal of values. Safety first was made the slogan for the railroad workers. Committees were appointed. Meetings were held. Conditions were revealed which needed correction. The mirror was held up before dangerous practices that showed them in their true aspect. Officers and men were brought into close personal contact in the pursuit of safety. Together they searched for the remedies for situations which their new relationship was compelling them to face, and together they began to realize that their interest was common in endeavoring to find an answer that would satisfy the conscience of each that the requirements of safety were being met.

When the enlightened conscience is satisfied with the contacts with life, as it is expressed in action as well as in word, that elusive and almost indefinable element which we call morale, appears; because an atmosphere which is conducive to its growth and development has been found. There is something in every real man that calls him to put his best effort into his work. He may vary somewhat in his response to this call, but the knowledge that he is working together with other individuals in the army of employees to carry out a program for protection, is a compelling force; because it is founded in sincere endeavor, and carried out in the spirit of service. Its outgrowth is quickened morale. The whole trend of the safety work is toward the promotion of those forces, sentiments and actions which inspire respect, loyalty, and efficient service. The work furnishes a point of contact between employer and employee that is mutually advantageous. From the experience there comes the knowledge that other points of contact are available, and the means of securing them follow closely.

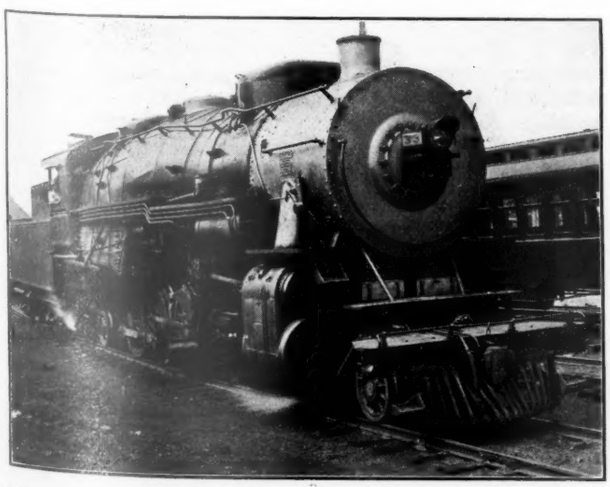
The principles on which safety work is founded, the sentiments which it fosters and the methods by which it develops have done more to build up morale upon the railroads than any other single agency. It has made for itself a place by providing an avenue for the expression of opinion, as well as the compulsion of safe practices, which entitles it to all the aid that can be extended, to the end that the work which it has begun in building up morale may be continued, sustained and enlarged by whatever additional means there may be provided to accomplish so important a task.

Force Feed Lubrication on Locomotives

An Original Method by Which Oil Is Automatically Supplied to the Various Bearing Surfaces

By A. H. Woodward
Chairman, Woodward Iron Company, Woodward, Ala.

SOME months ago the writer had an opportunity to ride on the engine of a local passenger train. There had been no oil or supplies put on the engine previous to leaving the terminal, but these were procured a little later at the roundhouse, two miles further along the line. The engineer did not oil around the engine as soon as the supplies were received at the roundhouse, but proceeded to the next station, which was 10 miles away, instead. Upon arriving at this point, the engineer oiled around while awaiting the unloading and loading of passengers and baggage. The running time between the two points was about 40 miles an hour. This engine had been run nearly 15 miles without any lubrication, after it had been standing approximately 16 hours.



Woodward Iron Company's Engine No. 30 Equipped for Forced Feed Lubrication

Of course, there is nothing new or remarkable about this procedure, nevertheless, the wear on the bearings alone would be enough to show that there was no economy in such a practice. The quantity of oil saved would be a very small amount in comparison to the cost of installing new bearings, so as a result of this experience, the writer went into the question of automatic lubrication for the locomotives of the Woodward Iron Company. After some investigation, one of the Santa Fe type locomotives of this company was equipped with three force feed pumps, one to oil the front truck and trailer, a second to oil all the driving wheel hub plates, guides, valve stems and pistons, rods, valve gear and shoes and wedges, and a third to oil the stoker.

Equipment

The pumps were supplied by the Lubricating Equipment Company, Birmingham, Ala., and are what is known as the "Forcit" type lubricator. Of the three pumps, two had a

capacity of five gallons and were equipped with 22 feed pipes; the third had a capacity of three gallons and provision was made for 12 feed lines. All of the pumps were provided with check valves.

The Alemite lubrication system was applied on the front and back ends of the eccentric blades, bottom and top link lifter, the trunion bushings, tumbling shaft boxes, the front and back ends of the union link, the front end of the radius rod, the top end of the combination lever, and on all the

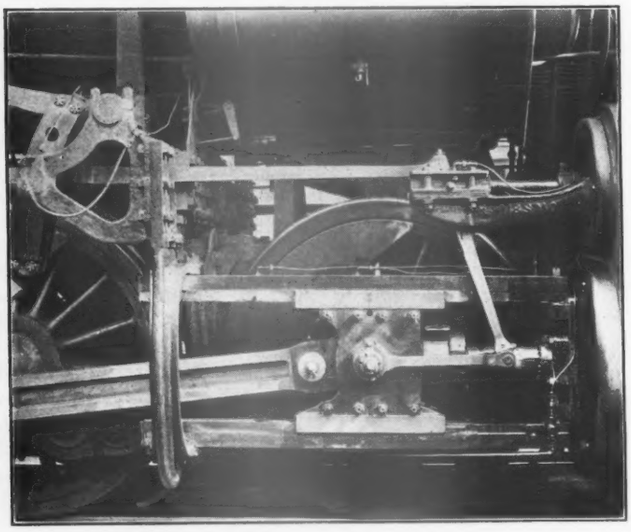


Fig. 1—Application of Feed Pipes to Valve Motion and Guides

knuckle pins and bushings. Practically every other bearing on the engine was fitted up for the use of an Alemite grease gun. The cylinders and valves were taken care of in the old way, with a steam lubricator.

Method of Installation

As partly shown in Fig. 1, the motion by which the pumps are operated, is taken from the valve gear on the right

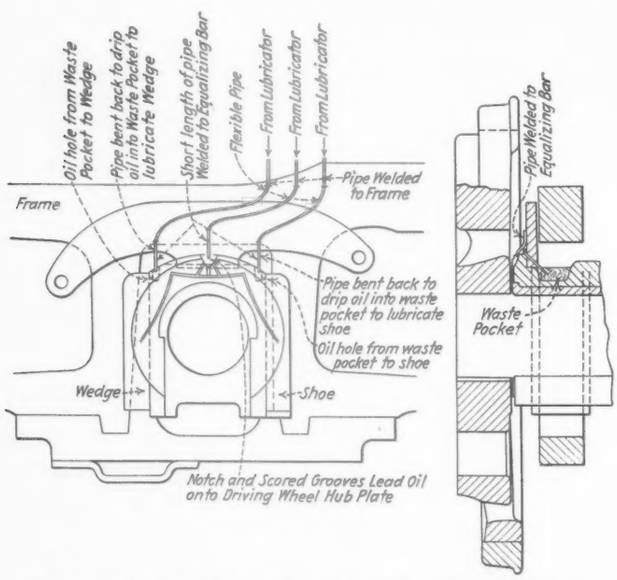
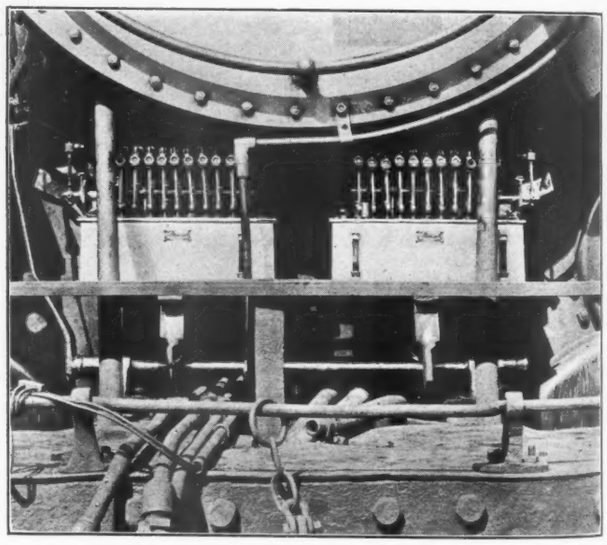

Oil hole from Waste Pocket to Wedge
Pipe bent back to drip oil into Waste Pocket to lubricate Wedge
Short length of pipe Welded to Equalizing Bar
Flexible Pipe
From Lubricator
From Lubricator
From Lubricator
Pipe Welded to Frame
Frame
Pipe bent back to drip oil into waste pocket to lubricate shoe
Oil hole from waste pocket to shoe
Wedge
Shoe
Notch and Scored Grooves Lead Oil onto Driving Wheel Hub Plate
Pipe Welded to Equalizing Bar
Waste Pocket

Fig. 2—Method Used for Lubricating the Shoes and Wedges

side of the engine by a connecting rod that extends to a crank arm placed under the smokebox. This crank arm is long enough so that it can operate both the pumps at the front end. Flexible pipe, fastened to the engine by means of clamps, is used to convey the oil to the various points of delivery about the engine. The force feed lubrication was applied to both sides of the engine at the following bearing surfaces:

Back driving box hub.
Main shoe and wedges.
Back intermediate shoe and wedges.
Front intermediate driving box hub.
Front shoe and wedge.
Front driving box hub.
Engine truck box.
Engine truck box hub.
Trailer truck box.
Trailer truck box hub.
Back shoe and wedge.
Front intermediate shoe and wedge.
Back intermediate driving box hub.
Main driving box hub.
Link block.
Valve stem.
Piston rod.
Back top guide.
Front top guide.
Bottom guide.
Outside valve stem guide.
Inside valve stem guide.

The method of application of the feed pipes at the valve gear and top and bottom guides, is also shown in Fig. 1. The arrangement of the delivery pipes for lubricating the



Two Lubricators Having a Capacity of Five Gallons Each Are Placed Under the Smoke Box

shoes, wedges and driving wheel hub plates is shown in Fig. 2. Three lines of flexible pipe are run from the lubricator to connections welded to the equalizer at three points over the driving box. The center connection is welded to the equalizer bar, as shown in the drawing, and passage is provided for the oil to feed into a waste pocket. Notches and scored grooves lead from the waste pocket to the face of the driving wheel hub plate. For the two outside connections, the pipe is bent back in order to drip oil into a waste pocket from which oil is fed the shoe and wedge.

The oil reservoirs on the force feed pumps carry a 10-days' supply of oil for this particular class of engines, which are operating on a 12-hour mine run. These engines now use about as much lubricating oil as when they were oiled by the engineer. The advantage gained by this system is that the oil is received automatically and regularly by all the bearing surfaces. After a four-months' trial, it appears that the life of the various bearings is going to be increased very materially. When the apparatus was first installed, the enginemen were inclined to look upon it with disfavor, but at the present time they seem to be much pleased with it.

Helpful Suggestions from Canadian Apprentice

Pleads for a Thorough Training Which Will Fit the Ambitious Boy as an All-Around Capable Mechanic

By F. O. Robinson*

Machinist Apprentice, Canadian National Railways, Fort Rouge Shops, Winnipeg, Man.

THE modern apprentice, if he is to make headway at his trade, must have a great deal more than practical experience. The time when that was sufficient is passed; the machinery of today is so highly developed and complicated that in order to make a first-class mechanic an apprentice must have considerable theoretical knowledge of mechanics, as well as a good general education. No mechanic today could possibly thoroughly understand all the different machine constructions, but it is essential that we have a good general knowledge of machinery, both theoretical and practical; and that in my opinion is what the apprentice should receive, as well as such lectures on moral and business subjects as will tend to increase his value to his company and country. Therefore, when a young man starts work with a company to learn a trade, he should be given as good an education under as competent paid instructors as it lies in the company's power to provide. Although I fully realize that the apprentice has been given opportunities to learn, and care has been taken to aid him in a number of ways, I believe there is still room for a great deal of improvement.

F. O. Robinson

The aim of the apprentice should be to become so well acquainted with the principles of mechanism that he will not only understand a certain number of machines, but from his knowledge of mechanical principles will be able to grasp the construction, design and operation of any unfamiliar piece of machinery that may be placed before him. In my opinion, the boy who is really interested in the trade he is learning should feel proud of his achievements and should stand ready to grasp and make good use of any opportunities that the company may offer to help to make him not only a good mechanic, but a resourceful, energetic and valuable workman in many other respects.

I do not think it will be out of the way here to outline a system which, in my opinion, would meet the needs of the modern apprentice. Of course, being a machinist apprentice in a locomotive shop, I shall write from that viewpoint.

Some Constructive Suggestions

When application is made by a lad who wishes to become a machinist apprentice, he should be taken in hand by the apprentice supervisor who should see that he is given an examination to determine as nearly as possible his mental power, character, alertness and education. The applicant should also be given a physical examination. If he passes both, he should be put to work in the shops for a probationary period of six months to determine whether he is really fitted to become a mechanic and is an energetic, conscientious worker. If he does not seem to be, it should be explained to him and he should be let go; in this way the misfits will be weeded out, the backward ones assisted and a higher standard established.

The apprentice supervisor should look after the welfare of the boys in general and oversee the work of the shop and school instructors. The shop instructor should be a man who is not only a good all-around mechanic, but can explain the theory related to each machine or job upon which the apprentices work. Each apprentice should receive thorough instruction on his machine its—construction, operation, repair and care. The shop instructor is too apt to become a kind of overseer of the conduct of the apprentice and shop instruction in its true sense may be forgotten.

There should be a regular schedule of shop work, a specified time on each machine, bench and floor job, and the apprentice should be given an examination on each machine before he leaves it. There is need of more instruction being given right in the shop where the machine is in front of the apprentice; the shop instructor should also give instructions in the shop on the use of hammer and chisel, shop scale, center punch, scriber, dividers, calipers, vernier calipers, micrometers, taps, etc., and the handling of all classes of wrenches and spanners, the level, plumb bob and surface gage; classification and use of files, scrapers and hack saws, rose bitting, reaming and countersinking. The working of each machine should be explained, as well as the tools used on it, and the best methods of setting up the work. Instructions should also be given on laying out on the marking off table. All this careful and thorough instruction is absolutely necessary if the apprentice is going to develop into an all-around, competent mechanic, and only men who can give it should be chosen as shop instructors. Care should be taken to place the apprentice with such workmen as will influence him in the right direction.

There should be a school of some kind at the shops and arrangements made for the apprentices to receive regular in-

*One of the papers which was awarded honorable mention in the competition for regular apprentices. The prize winning papers will be found in the January and February issues.

struction. Any good mechanic should not be eligible to the position of school instructor if the apprentice is to receive thorough and proper instruction. He should, if possible, have a teacher's certificate, or if he has not should possess a great deal of the ability of the professional teacher, as well as a good general knowledge of the science of mechanism. The apprentice should be allowed as long a time at school as the company can possibly spare, because it is there that he receives the true foundation for his shop work; without this school training he cannot hope fully to grasp the shop instruction and work.

School instruction should cover simple arithmetic, including reviews in addition, subtraction, multiplication, division, fractions, decimals, etc.; drawing, geometrical and mechanical; shop mathematics, including algebra, geometry, plane trigonometry; physics as it concerns simple machines, power transmission, horsepower, strength of materials and machine design. It should also include general studies, such as the hardening, tempering and selection of steel, classification of metals, care of machine tools, and some text book study. The school instructor should also give practical and theoretical detailed lectures on valve setting, air brakes, stokers, lubricators, injectors, boosters, feedwater heaters, etc., the locomotive in general and all its appliances. In my opinion, only a small portion of the time at school should be spent on text book study, as this is work which the apprentice can do at home, if he will, and I see no reason why one apprentice who will not study at home should be allowed to hold back those who are willing to. A regular system of study should be provided at the shop school and the classes arranged according to the ability and progress of the pupils, so that the backward ones will not hamper the others.

Special Lectures and Instructions

If possible, special lectures and instructions might be given to apprentices willing to attend outside of shop hours without pay. It would also be a great advantage if a small building or car could be equipped with machinery suitable for giving practical detailed instructions on the locomotive and its appliances, their construction and repair; the principle of the different machines, their construction and operation, etc.; and such practical work as could not very well be given in the school.

Moral and educational lectures could be given in this building by college professors and business men, which would all tend to keep up the apprentices' interest. A small library of good mechanical books and magazines might also be found useful in connection with this department, where the apprentice can spend his spare time in the evenings if he wishes. An educational club could be formed among the boys and debates on mechanical subjects arranged; competitions could be held and suitable prizes awarded the winners, such as tools, etc. Apprentices at outside points could compete by mail when possible, thus keeping all the apprentices in touch with each other. Talks by the company's officials and foremen all help to encourage the boys. It might help also if the apprentices' parents were kept posted on their progress.

It is absolutely essential in railroad work that the mechanic be an all-around man. To make the apprentice an all-around mechanic, four years is not sufficient and five is barely so; yet it is necessary because when an apprentice has finished his time, he may be sent out to a small roundhouse where he may be called upon to do some different job or operate a different machine daily; aside from that, however, an all-around training is necessary to produce a capable mechanic.

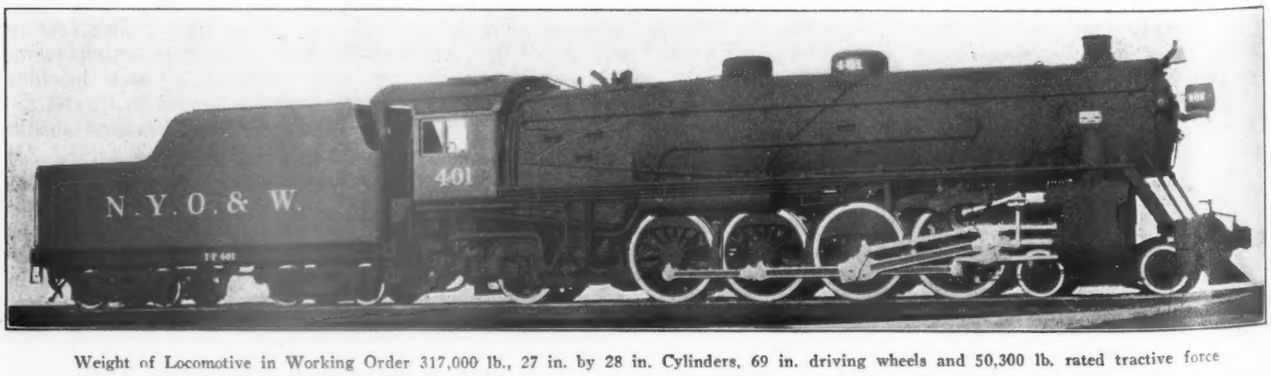
Advantages of Thorough Training

The value of apprenticeship training cannot be estimated in dollars and cents, for by the proper training of the apprentices the whole community is raised to a higher level of intelligence, ability and good will; also there is the advantage of having properly trained men to fill positions as foremen and officials in the company's service; men who are already versed in the standards and methods of the company are far superior to outsiders. Many companies complain that they give an apprentice a good training and then when he is finished he leaves them; generally, however, a good majority of the boys stay with the company, and, again, even if they do leave, they are started out in the world with the advantages of a good training. Of course, apprenticeship is only good so long as the apprentice has time to learn and the employer, or someone deputed by him for this specific purpose, has time to teach.

I think we ought to be very grateful to the company for what has already been done.

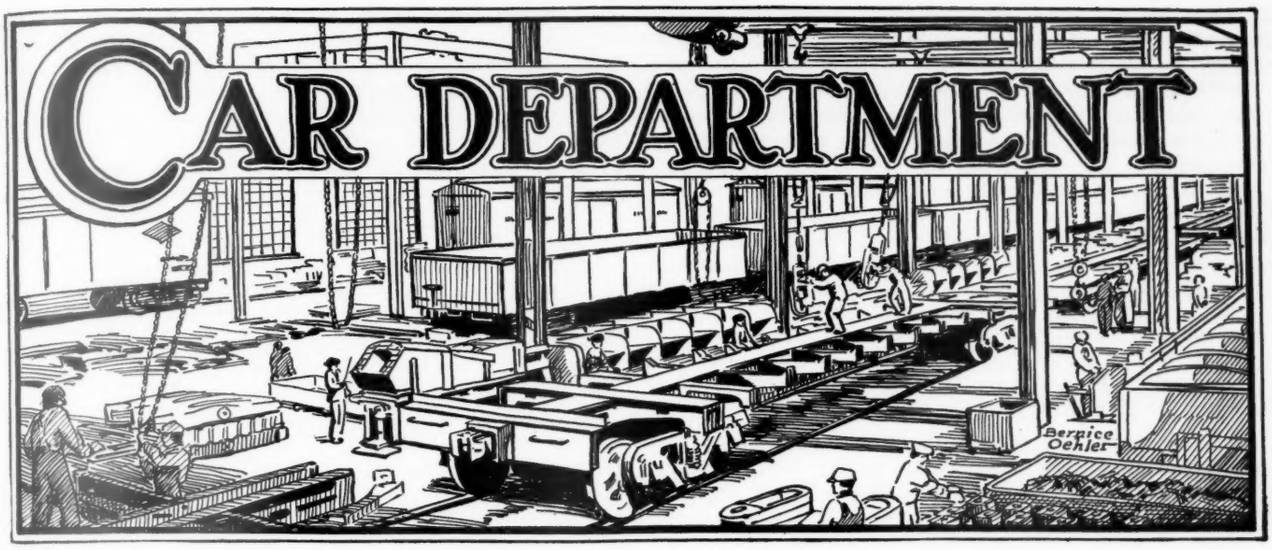
A Correction—J. Barraja-Frauenfelder

In connection with the article, "The Next Step Is the Thermo-Locomotive," which appeared on page 81 of the February issue of the *Railway Mechanical Engineer*, a brief biographical note was given showing the business connections and the work done by the author, J. Barraja-Frauenfelder. Through an oversight, mention was not made of the fact that he was the chief engineer of the Lake Torpedo Boat Company from 1914 to 1923. Mr. Barraja-Frauenfelder came to the country first in 1901, and returned to Italy in 1913 for a short time to accept the position of chief engineer of the Spezia Works of the Fiat-San Giorgio Company.



Weight of Locomotive in Working Order 317,000 lb., 27 in. by 28 in. Cylinders, 69 in. driving wheels and 50,300 lb. rated tractive force

Mountain Type Passenger Locomotive for the New York, Ontario & Western, Built by the American Locomotive Company



Ventilation and Heating of Passenger Cars*

Part I—Ventilation

Composition of Air, Factors Related to Required Volume of Supply, With Suggestions for Economical and Effective Ventilation

By K. F. Nystrom
Engineer of Design, Chicago, Milwaukee & St. Paul

THE ventilation and heating of railway passenger cars are subjects so closely allied that in order to understand one, it is necessary to have a fundamental knowledge of the other. Writers on these issues generally consider the problem of heating first and ventilation as a subject of secondary importance. It seems, however, that a correct understanding of the requirements for good ventilation should form a foundation for the study of the problem of heating passenger train cars.

Air consists chiefly of the two gases, oxygen and nitrogen with small proportions of other gases, such as carbon dioxide (CO_2), ozone, aqueous vapor and argon. Oxygen, which is the active constituent and upon which life and combustion depends, forms about one-fifth by volume of the whole, while nitrogen, which is inert, forms nearly four-fifths.

The carbon dioxide in the air amounts only to about .035 per cent by volume, but is generally assumed to be .04 per cent or 4 parts in 10,000. It is produced by the burning and decaying of vegetable and animal matters and by respiration. The percentage in the air remains practically constant because, under the influence of the sun, the foliage in the plant world assimilates the carbon dioxide and liberates free oxygen. All the carbon contents in plants, including trees and coal, originates solely from the carbon dioxide contained in the air. The assimilation process and the procedure which takes place during oxidation or burning, which in general includes respiration, are entirely opposite to each other. The assimilation process in the plant world produces from carbon dioxide and water an organic substance and free oxygen. When organic substances burn, decay, or are oxidized in the processes of animal life, carbon dioxide and water are again formed.

Water vapor is due to the oxidation process described and to the evaporation from bodies of water and also from the animal body. The amount of water contained in the air varies with the temperature and the available water supply. This vapor is not always sufficient to saturate the air. The ratio of the amount contained to that required for saturation is called "relative humidity," while the actual amount of vapor per cubic foot is known as the "absolute humidity." Thus at 75 deg. F., air may contain 0.00135 lb. or 9.5 grains of water vapor per cubic foot. This quantity will just saturate it. If the air is half saturated, the relative humidity is 50 per cent, and the absolute humidity is 4.75 grains to the cubic foot.

The proper and healthful relative humidity of air has only in recent years been given the thought and attention it rightfully deserves, despite its influence upon personal comfort and health. Water vapor is issued from the human body in two ways: In exhaled air when breathing and through perspiration. From 1½ to 2 lb. of water are evaporated daily from the skin of a person at rest. This evaporation as well as any other evaporation takes place due to application of heat. The source of heat in this instance is the human body itself and the rate of evaporation is affected by the motion, temperature and humidity of the surrounding air. Evaporation takes place by direct application of heat and is essentially a refrigeration or cooling process. Heat being abstracted from the body for this purpose naturally tends to lower the surface temperature and we actually feel several degrees cooler than the temperature recorded by the thermometer in the room. As heated or warmed air is expanded by heat, the percentage of moisture or relative humidity is lowered with the result that the capacity of the air for absorbing moisture is greatly increased. Under these conditions, we experience the sensation of dry heat. This causes

*Abstract of a paper presented at the meeting of the Canadian Railway Club held in Montreal, February 12, 1924.

an excessive and unnatural evaporation of moisture to take place from the skin and membranes of the respiratory organs.

The human body is a very sensitive power plant and it is obvious, therefore, that such an important function as perspiration can only act properly inside extremely narrow limits.

Fig. 1 shows the relation between temperature and relative humidity of rooms and their bearing on the comfort of the occupants. This chart establishes what is called the "comfort zone" in which the relation between relative humidity and the temperature is given by the equation

R = 100 — 4 (T—54)
R = relative humidity
T = any temperature above 55 deg.

From this chart it is seen that a person can remain comfortable even though there exists a considerable variation in

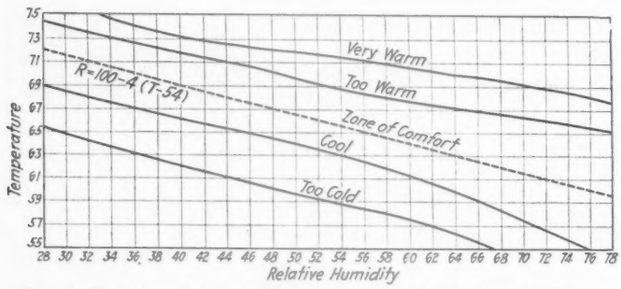


Fig. 1—Relation Between Temperature and Relative Humidity

temperature provided the relative humidity is such as to keep the dispersion of total heat from the skin constant. For this reason a thermometer can not alone be depended upon to measure comfortable air conditions for the occupants in a room because it does not include any measure of the moisture in the air. In order to measure the relative humidity and thereby ascertain a comfortable temperature, hygrometers, or wet bulb thermometers, should be employed to a much greater extent than at present. It may be that the future heat controls used in connection with heating cars will be regulated by means of hygrometers or, quite possibly, by a combination of thermometer and hygrometer. A heat control of this kind would undoubtedly result in a great saving of fuel.

Influence of Occupants on Temperature and Humidity

Respiration and the presence of the occupants in a room not only increase the carbon dioxide content in the air, but may add materially to the heat and moisture content of the air as shown in Table I.

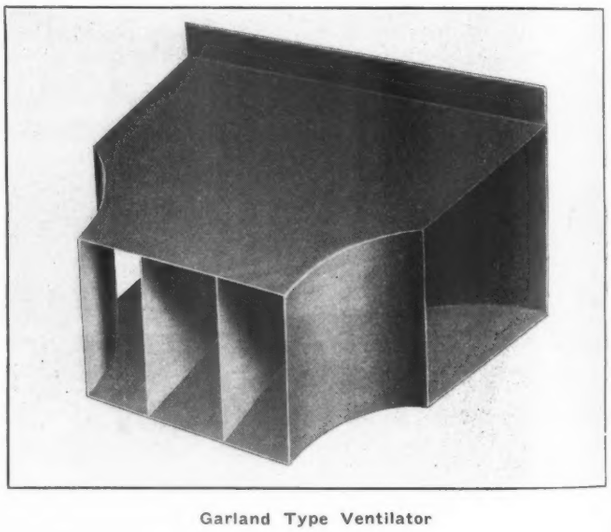
TABLE I.—HEAT AND WATER VAPOR GIVEN OFF BY PEOPLE
(Harding and Willard)

	B. t. u. per hour	Water vapor per hour, lb.
Man at work	794	0.267
Man at rest	397	.155
Youth	357	.088
Infant	103	.029

All life processes are accompanied by the generation of heat from within. The blood serves to carry oxygen from the lungs to remote tissues, where combustion takes place, and carbon dioxide is carried back and eliminated by the lungs in respiration. As a result, an average normal temperature of 98.6 deg. F. is maintained. Normally, a uniform, but not too rapid, dispersion of heat must be maintained if the individual is to remain comfortable. The rate of dispersion by radiation, evaporation, etc., must equal the rate of heat generation. Hence it appears that the only function of external warming is to reduce the rapidity with which the body parts with or gives off its heat.

An average adult must throw off about 400 B.t.u. per hour for comfort, of which about 30 per cent is lost by contact with the air, 43 per cent by radiation and 27 per cent by exhalation and other means. A part of the 30 per cent, which is absorbed by the air coming in contact with the body, is carried off in water vapor. At a room temperature of 70 deg. F. and a relative humidity of 70 per cent, it will take at least four cubic feet of air per minute to carry off this water which is evaporated from the skin.

The radiation is noticeable to the sense of touch. Air, if dry, is a nearly perfect non-conductor but allows radiation to take place through it readily, hence, in a room with very dry air at 75 deg. F., a person may feel cold if the walls are at 50 deg. F. due to radiation loss from the body to the cold wall surfaces. This condition has an important bearing upon passengers in a railway car. Many cars of all steel construction are not properly insulated with the result that inside walls are cold and, notwithstanding that the inside temperature seems to be satisfactory, the passengers are uncomfortably cold or warm. Window sills and arm rests in all steel passenger cars are generally made of wood so as to avoid passengers coming in direct contact with the steel. This prevents a conduction of heat from the human body, but it does not eliminate the radiation. Designers of passenger cars should take into consideration what effect radiation has upon the comfort of passengers, when calling for new equipment. The ideal inside wall surfaces should, therefore, be either non-conducting, or serve as reflectors of heat rays, or should preferably combine both qualities.



Garland Type Ventilator

This will explain the use of a mirror finish employed on the interior of a vacuum bottle.

The gases and water vapor thrown off from a person under average room temperature conditions (70 deg. F. temperature and 70 per cent relative humidity) is of a higher temperature than the surrounding air and, therefore, lighter. Thus it will be seen that vitiated air will not fall to the floor as has often been presumed, but will naturally rise above the level of the breathing line and immediately diffuse itself into the surrounding air.

Effect of Carbon Dioxide Content on Required Air Supply

An adult at rest requires 20 cu. in. of air at each respiration and will make from 16 to 24 respirations per minute so that a total of from 320 to 480 cu. in. of air, or about 15 cu. ft. per hour, is required. This amount may be increased by exercise. Since this exhaled air contains about 400 parts of carbon dioxide (CO_2) per 10,000, an adult at rest gives off CO_2 at the rate of 0.6 cu. ft. per hour.

Hence in order to maintain the CO_2 content at a fixed

amount for each adult we must supply outside air containing 4 parts per 10,000.

$$C = \frac{a \times b}{n - 4} = \text{cu. ft. of outside air per min.}$$

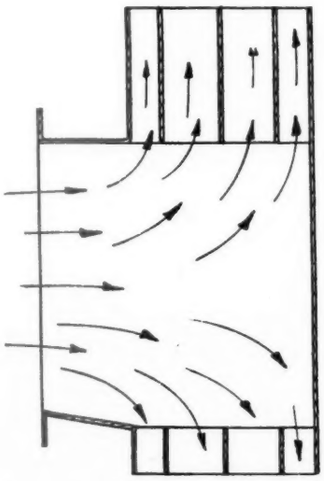
Where a and n = parts of CO_2 per 10,000 for respired air and standard of purity respectively; b = cu. ft. per hour of CO_2, the amount an adult at rest gives off, ordinarily 1.5 cu. ft.

Example: Assume it is desired to have the content of CO_2 in a room maintained at 10 parts in 10,000. How much outside air will have to be supplied for each adult?

$$\frac{400 \times 0.25}{10 - 4} = 16.6 \text{ cu. ft. per min. or}$$

$$16.6 \times 60 = 1{,}000 \text{ cu. ft. per hour}$$

In this case, therefore, it will require 1,000 cu. ft. of outside air per hour for each adult to maintain the CO_2 ratio



Air Currents in Honeycomb Type of Utility Ventilator

of 10 parts per 10,000 in an enclosed place. In the accompanying Table II, the CO_2 content has been calculated on the basis of 4 parts of CO_2 in 10,000 of outside air.

TABLE II—VALUES OF C FOR VARYING VALUES OF N FROM 5 TO 20

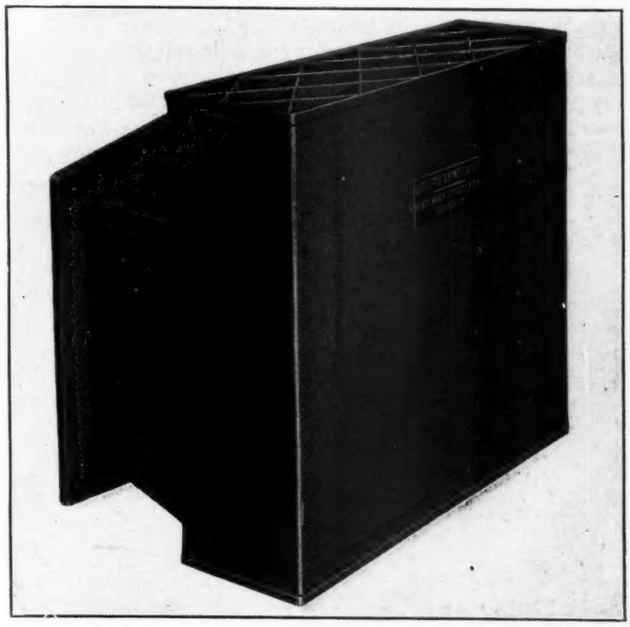
Vitiation allowed parts of CO_2 per 10,000 in the room air Parts (n)	Cu. ft. of air containing 4 parts of CO_2 per 10,000 to be supplied per person or equivalent a person = 0.6 cu. ft. CO_2 per hr.	
	Per minute (C)	Per hour
5.0	100.0	6,000
5.5	66.6	4,000
6.0	50.0	3,000
6.5	40.0	2,400
7.0	33.3	2,000
7.33	30.0	1,800
7.5	28.6	1,714
8.0	25.0	1,500
9.0	20.0	1,200
10.0	16.6	1,000
15.0	9.1	545
20.0	6.2	375
30.0	3.8	231

The old theory that the sensation of discomfort arising in enclosed space was due to either an excess of carbon dioxide or an insufficient amount of oxygen, has been discredited. On the testimony of numerous experimenters, it has come to be generally agreed that an atmosphere containing less than three per cent of pure carbon dioxide and as high as 15 per cent oxygen, has no toxic effect and produces no distressing symptoms. It is very rare for the CO_2 produced by respiration to contaminate the air of any room, even with the poorest ventilation, to the extent of more than 50 parts in 10,000, which is one-half of one per cent. This amount of carbon dioxide alone has no harmful influence, according to the best available evidence.

In ventilation, the fact has been generally accepted that carbon dioxide in such amounts as is likely to be found in inhabited rooms, even up to 50 parts in 10,000, is in itself entirely harmless, but that when this is due to respiration, certain poisonous organic bodies are also present of which the carbon dioxide is an accurate index. The allowable amount of carbon dioxide as respiratory impurity has been variously placed at from 2 to 10 parts, which together with the amount already in the air, makes a total of 6 to 14 parts CO_2 per 10,000 of air. The limit is established by that degree of contamination at which the sense of smell begins to give the first indication of closeness to one entering the room from without. It has always been recognized that high standards of personal cleanliness would allow this limit to go higher than when such standards are low, that those within do not perceive any odor as readily as one entering, and that the contamination at which discomfort develops is susceptible to wide variations. As a result of their work, Haldane and Osborn recommended a limit of 12 volumes of CO_2 per 10,000 by day and 20 volumes by night when gas or oil is used for lighting. It has been generally stated that about 10 volumes of CO_2 in 10,000 allows a fair margin of safety. The ordinances for Chicago as they affect the ventilation of the street, elevated and suburban cars provides that the CO_2 content for a maximum loaded car shall not exceed 12 parts in each 10,000 parts of air.

Carbon Dioxide Content in Relation to Modern Car Ventilation

The most generally adopted measure of ventilation is the carbon dioxide standard in which the necessary amount of air for ventilation is figured from the amount probably



Utility Ventilator for Side-Deck Cars

emitted into a given space by its occupants, and the permissible amount that may exist in the air. Today, however, the attainment of this standard alone will not satisfy the requirements of modern ventilation.

The carbon dioxide content is controlled by the supply of air from outside the car. It is, therefore, necessary to ascertain the required air supply. We will take a 70 ft. coach and assume that the maximum number of passengers is 105, which is equal to one and one-half passenger per lineal foot. This allows for approximately 25 per cent above the seating capacity. The cross sectional area of an average passenger car is approximately 80 sq. ft. The CO_2 contents should not be more than 10 parts in 10,000 parts of air

which is equal to an air supply of 1,000 cu. ft. of air per hour per each occupant.

The air will therefore be changed:

$$\frac{1{,}000 \times 1.5}{80} = 18.5 \text{ times each hour in the car}$$

The total air supply in the car will be equal to

$$1{,}000 \times 105 = 105{,}000 \text{ cu. ft. per hour}$$

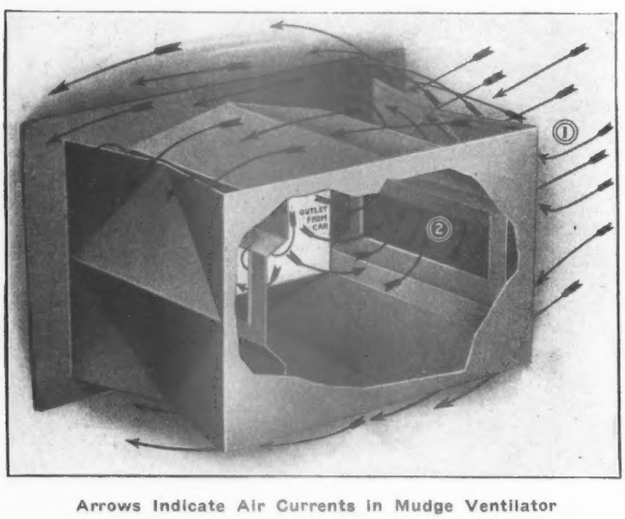
Several exhaust ventilators now on the market will discharge air at a rate of 15,000 cu. ft. or more per hour at a 20-mile train speed. The number of ventilators required will then be

$$\frac{105{,}000}{15{,}000} = 7 \text{ per car in the car body}$$

For a symmetrical arrangement of ventilators it would be desirable to use eight ventilators on a 70-ft. coach. It will, of course, be necessary to apply one ventilator in each toilet.

This number of ventilators probably is less than generally applied at present, but it is contended that in many instances the ventilation of passenger cars is overdone. With the incessant public fault finding with everything pertaining to a railroad, we have sometimes gone to unnecessary extremes in the matter of ventilation to please the traveling public.

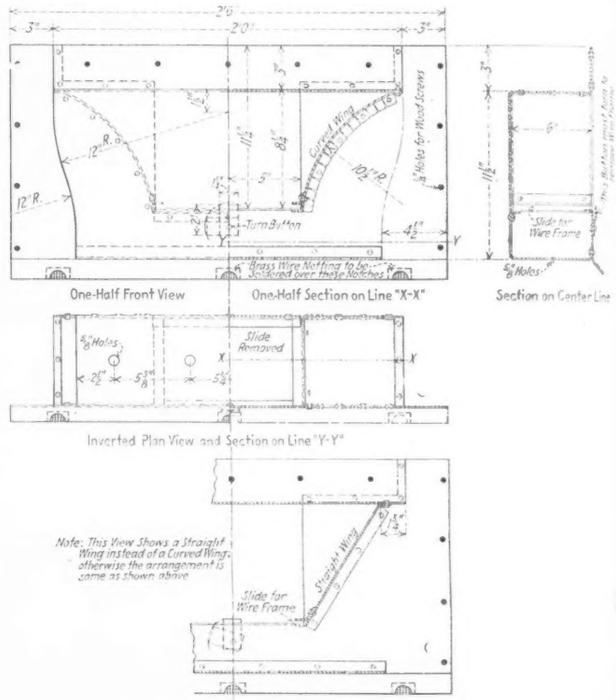
The application of too many ventilators wastes fuel, as a large volume of air will have to be heated for keeping the passengers comfortable, without adding materially to their well-being. There is also a real objection when too many exhaust ventilators are applied, as they create too great a vacuum. Excessive vacuum makes it difficult to close the doors and has a tendency to raise the water in the hoppers when flushed, as the air will rush into the car and splash the water into the toilet room, causing trouble and inconvenience. In a number of coaches recently constructed by a large railway system, the installation of a standard make of exhaust ventilators proved to be too powerful, as the water was raised in the hoppers when flushed. The doors and windows were



Arrows Indicate Air Currents in Mudge Ventilator

equipped with efficient weather stripping and to overcome the high vacuum created by the ventilators, air intakes had to be provided after the cars were placed in service.

In an ordinary passenger car, no intake is provided for as the small clearances around doors and windows are depended upon for inlets. It seems incredible that a volume of say 100,000 cu. ft. of air per hour could find its way through small crevices around closed doors and windows, but Dr. Crowder in his test of ventilation in sleeping cars has measured up to 30,000 cu. ft. per hour passing out through the ventilator duct from a small state room with the door and windows closed. Natural crevices are, therefore, sufficient air inlets if properly utilized and not too many ventilators installed, and they possess a vast advantage over larger openings. The incoming jets of cold air are individually so small and they take such irregular motions in mixing with the more quiet air within, that all the good effects of varied temperatures and motion are obtained without the disadvantages of uncomfortable cold draughts. Air coming through crevices around windows enters the car at or below the breathing zone and, therefore, at an ideal location. In some cars, particularly in sleeping cars, a small adjustable intake is provided in the bottom rail of the window sash. The location of this air intake is ideal and has the advantage


One-Half Front View
One-Half Section on Line "X-X"
Section on Center Line
Inverted Plan View and Section on Line "Y-Y"
Slide Removed
Slide for Wire Frame
Turn Button
Curved Wing
Straight Wing
Note: This View Shows a Straight Wing instead of a Curved Wing; otherwise the arrangement is same as shown above

C., M. & St. P. Ventilator for Upper Deck

that the occupant of the seat can regulate the air supply to suit himself without causing discomfort to others.

Mechanical Refinements Required for Ideal Car Ventilation

Natural exhaust ventilators as applied in passenger cars depend for their operation upon the speed of the train. Therefore, they function only when the train is in motion. At slow speed and when the train is standing, they do not exhaust the necessary amount of air and at high speed are too powerful. These types of ventilators should have a compensating exhaust capacity. That is, after a predetermined capacity is reached, the area of the exhaust opening should be reduced to maintain a constant volume of air leaving the car. To take care of ventilation at a slow speed or when the train is standing, it would be desirable to install exhaust fans. These fans could, partially at least, be controlled by thermostats or probably anemometers. Exhaust fans should be installed in all smoking rooms and special fans are a necessity in kitchens of dining cars.

The ideal system for ventilating passenger cars would be to have the air, by mechanical means, forced into the car at a predetermined temperature and washed free from dust and bacteria. Unfortunately a passenger car is too small a unit to warrant the expense of installing such a plant. Several attempts have been made to provide cars with forced air intakes, but without success, as it draws into the car a considerable amount of dust and is also noisy. It may be

that in future passenger cars the heating system will be utilized in extremely hot weather, as a cooling system. This would greatly increase comfort in traveling, particularly when waiting for trains to leave at terminals.

In large buildings where washed and humidified air is forced into the rooms, it is comparatively easy to have the humidity under control, but despite the difficulty of applying the same methods to passenger cars, much could be accomplished in this direction toward increasing the comfort of travel. A great improvement in regulating the temperature of passenger cars could also be effected if hygrometers (wet bulb thermometers), were employed instead of using thermometers alone. Another practical possibility lies in the installation of a humidifier of simple construction in connection with the vapor heat. It is realized that it would be difficult accurately to control the humidity in a car, but a decided saving in fuel could be realized and conditions could be so much improved upon that serious consideration should be given to the latest possibilities suggested.

Heat control in a passenger car does, strictly speaking, not come under the subject of ventilation, but if the heat was properly controlled, the problem of ventilation would largely be solved. When passengers are uncomfortable and the car feels "stuffy" it is due, in the majority of cases, to overheating and unsuitable humidity. If the temperature were reduced and the steam shut off, the passengers would have immediate relief.

Dust is the most difficult feature to control in connection with the ventilation of cars. As previously mentioned, it has not proven practical to install air washing machines in passenger cars. During the greater portion of the year passengers will insist upon keeping windows and doors partly opened and during this period any air purifying system would be of no value.

Bacteria in the air is principally carried into the car with dust and, as in the case of dust, little can be done to exclude it. When we consider, however, that the train traverses mostly open country where the air is practically free from bacteria, the conditions are very satisfactory when compared with similar situations in city vehicles. It is, however, important to keep the cars clean. As a rule, this is carefully looked after by most railroads. The public, generally, knows nothing of the painstaking care put forth to keep passenger equipment in a sanitary condition. This, however, requires the constant attention of mechanical officers for if it is not followed up it naturally will be neglected.

Odors in the car, although in the majority of cases harmless, are disagreeable. Ventilation will reduce but not remove them. If the odor is due to a condition originating in the car itself, it is in the hands of the mechanical department to have the source removed, but if it originates from occupants with, for instance, a decided taste for garlic, we are confronted with a condition which cannot be remedied as long as the garlic lover remains in the car.

Diffusion of Air in Passenger Coaches and Sleeping Cars

Diffusion of the air in a passenger car with the ordinary system of ventilation has been proven by tests to be good. Air being a gas requires time to mingle and come to a mean temperature. Perfect diffusion of gases of varying temperatures and densities is not instantaneous, the time required varying inversely as the density and directly as the square root of the absolute temperature.

Air as a mixture, however, seeks different levels, according to its relative temperature. The influence of objects relatively hotter or colder than the air itself, therefore, may be employed to aid ventilation. Thus the cold area of glass in a window causes a downward current of air in its vicinity, while the heat from the human body gives rise to a general upward movement.

Air has a peculiar property to penetrate, for instance, clothing. It is generally conceded that the lower berth in a sleeping car is not as well ventilated as the upper berth on account of the former being entirely closed in by the berth curtain. Tests, however, have proved that the supply of air to the lower berth is really somewhat larger than in the upper, and there exists little difference between CO_2 content of the air in the aisle and in the berth. This condition is due to the ability of the air to diffuse and penetrate.

Economical and Efficient Ventilation

1. Carbon dioxide, CO_2, need not exceed 10 parts in 10,000 parts of air. This is equivalent to 1,000 cu. ft. of air per passenger per hour.

2. Humidity in the car should be controlled inside reasonable limits.

3. Heat should be controlled automatically with respect to the humidity in the air. Under no condition should the car be allowed to become overheated.

4. Air motion should be slight enough so that it is not annoying as a draft, yet strong enough to change the envelope of air around the body continuously, so as to maintain uniform evaporation at a constant temperature.

5. Dust should be kept out of the car as far as practical. Cars must be systematically cleaned daily. Where cars lay over at terminals, they should be thoroughly scrubbed and dusted both inside and outside.

6. Bacteria in a car will be kept down to a minimum if the car is kept clean and free from dust.

7. Odors can be controlled by the railroad only so far as this affects the sanitary condition of the car. Here, however, the conductor and the trainmen can be of considerable assistance by tactfully assigning passengers having a low standard of cleanliness to certain cars.

8. Diffusion of the air in the car will best be accomplished, under present systems of exhaust ventilation, by providing a plurality of very small inlets.

9. Ventilators in the car should be opened only in proportion to the number of passengers, so as to save fuel. If a proper ventilating system is installed, only half of the ventilators need be operated if the car is half full.

10. Rules should be issued to trainmen instructing them how properly to operate the ventilating systems in order

DIFFERENT METHODS OF VENTILATION COMPARED SHOWING LARGER AIR SUPPLY WITH THE EXHAUST METHOD (801 OBSERVASIONS IN 183 CARS)

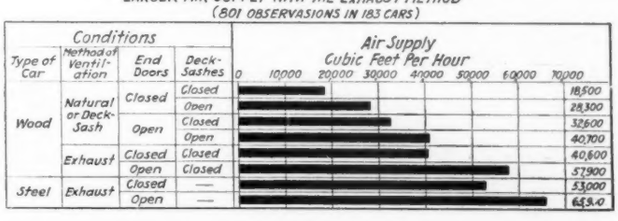


Chart No. 2—Average Ventilation of Sleeping Cars

to obtain the maximum comfort for the passenger at a minimum cost to the railroad.

11. Water seals in hoppers and in drain pipes from washstands and water cooler should be of sufficient depth to assure a perfect seal at all times. This is an important item in keeping the car in a sanitary condition.

12. In toilet rooms and probably in drawing rooms and compartments, efficient ventilation can be obtained by installing a chimney extending from floor to deck. At the floor, the chimney should be provided with a shutter and at the deck connected to an exhaust ventilator. With this system, odors are removed near the floor, thus minimizing their tendency to rise to the breathing zone. Incidentally, the

heat loss is at a minimum as the air is removed from the coldest part of the room.

Ventilating Systems Now in Use on Passenger Cars

The introduction of deck sash was the first attempt to provide for ventilation in passenger cars and then followed a variety of types of ventilators, practically all depending for their operation on the speed of the train. Therefore, they are only satisfactory at a certain speed and do not function when the train is standing in a station when, particularly in summer time, relief is needed most. This method of ventilation costs nothing to operate, neither does it accomplish entirely satisfactory results. In the summer doors and windows are opened which somewhat improves the condition, particularly when the train is in motion. Dr. Crowder has made extensive tests of passenger cars in respect to ventilation. These tests included cars equipped with deck sash and exhaust ventilators. Chart No. 2 shows these tests and represents the average air supplied, as determined from the CO_2 in the breathing zone, while cars were running in regular service at ordinary speed and with various possibilities as to air inlets and outlets. The significant bars of the chart, indicating where no intakes in addition to crevices were provided, are the first, fifth and seventh. Unaided by exhaust ventilators, the average car supply through

Location / Method of Ventilation	CO_2 Per 10,000 of Air	Air Supply Cu. Ft. Per Person Per Hour (0 1,000 2,000 3,000 4,000)
LOCATION COMPARED FOR EACH METHOD		
DECK-SASH VENTILATION (WOODEN CARS)		
Upper Berth	8.73	1270
Lower Berth	8.32	1390
Aisle	7.32	1810
EXHAUST VENTILATION (WOODEN CARS)		
Upper Berth	7.19	1880
Lower Berth	6.96	2030
Aisle	6.33	2570
EXHAUST VENTILATION (STEEL CARS)		
Upper Berth	7.00	2000
Lower Berth	6.76	2170
Aisle	5.90	3160
METHODS COMPARED FOR EACH LOCATION		
UPPER BERTH		
Deck-Sash Ventn.	8.73	1270
Exhaust (W. Cars)	7.19	1880
Exhaust (S. Cars)	7.00	2000
LOWER BERTH		
Deck-Sash Ventn.	8.32	1390
Exhaust (W. Cars)	6.96	2030
Exhaust (S. Cars)	6.76	2170
AISLE		
Deck-Sash Ventn.	7.32	1810
Exhaust (W. Cars)	6.33	2570
Exhaust (S. Cars)	5.90	3160

Chart No. 3—Relative Ventilation of Upper Berth, Lower Berth and Aisle

crevices alone was only 18,500 cu. ft. per hour, aided by exhaust ventilators the averages were 40,600 and 53,000 cu. ft. per hour for wooden and steel sleeping cars respectively. The difference between the latter two is believed to depend upon the almost total absence in the steel car of crevices in its upper portion, by reason of the absence of deck sash and a consequent absence of short-circuiting of air currents from deck sash crevices to ventilators necessarily close at hand. There is in consequence a more constant withdrawal from below and a more rapid changing of air of the lower levels, particularly at the breathing zone where it is most needed. A study of this chart will reveal that cars equipped with deck sash only provide a fair average ventilation in sleeping cars. Chart No. 3 shows the average air supply per occupant and the CO_2 content in the car at different locations. Where tests were made of CO_2 contents in a berth it had but one occupant. Each group in the chart represents an average of 16 passengers in each car. Where ventilators were used, six were installed in each car. It should be noted that these charts represent average conditions and include regular stops of train in service. Therefore, both the volume of air supplied and the CO_2 content vary considerably.

Any type of ventilation will function satisfactorily within certain limits if it is maintained in working condition. However, the simplest system with deck sash can be rendered inoperative by allowing it to clog up. An inspection will often reveal that the deck screens are filled with dirt hardly allowing any air to pass through. The same condition often exists with ventilators having screens, even the air ducts in the ventilators themselves are often filled with dirt and cinders. Under those conditions, not much relief can be expected from the ventilating system.

Granting, however, that the ventilating system is in first class condition and the car is delivered to the terminal in a clean, sanitary condition with correct temperature, the train departs from the depot but in a very short time the car is stuffy. What has taken place? The conductor has turned on all the steam he can and probably opened one or two deck sash or ventilators. What he should probably have done was to have turned off all the steam and opened all the ventilators and probably the windows in the end doors. Trainmen should be guided by indicating instruments such as hygrometer and thermometer combined to give instant reading of the degree of comfort in the absence of automatic control.

Recommendations

The first two recommendations submitted will improve the present system without any cash outlay. The other recommendations are to some extent contingent upon the amount the railroad is able to set aside for improvement to rolling stock.

1. Keep deck screens and ventilators clean—regular periodical cleaning.
2. Educate trainmen how to use deck sash or ventilators for the comfort of the occupants of the car and that overheating means discomfort to passengers and loss of money to the railroad company.
3. Install exhaust fans in smoking rooms and kitchens of dining cars.
4. Close up permanently all deck sash and install natural exhaust ventilators in body of car and in toilet rooms. It would be desirable to supplement the ventilators in the body of the car with at least two exhaust fans.
5. Install automatic heat control to prevent discomfort of occupants from overheated cars and loss of money by the railroad.

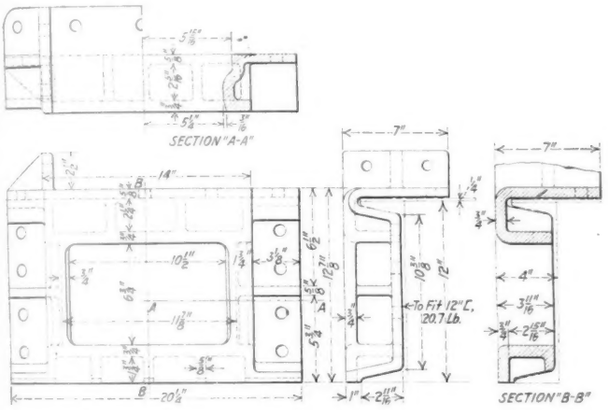
(*Part II, dealing with the heating of passenger cars, will be given in the next issue.*)

BULLETIN NUMBER SIX, issued by the Railway and Locomotive Historical Society, 6 Orkney Road, Brookline, Mass., shows the Carrollton Viaduct, on the Baltimore & Ohio, near Baltimore, as it existed in 1829, with one car, drawn by a horse, passing over it. The most prominent article in the issue is a list of locomotives as reported to the Congress of the United States in the year 1838. It appears that this was made up by the Treasury Department, at the request of the House of Representatives, and no doubt is quite complete. It includes stationary engines and the engines of steamboats as well as railroad locomotives, and the total number is over 3,000. The number of locomotives is about 350. Fifty-four railroads are named, and 39 builders. Of the builders, 11 are English manufacturers. The principal American shops represented were located in Lowell, Philadelphia, Boston, New York, Paterson and Baltimore.

57½-Ton Hopper Bottom Gondola for C. & O.

Careful Designing Increases Strength, Substantiability and Capacity With Little Addition in Weight

THE first lot of new steel freight cars built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., was 1,500 steel hopper bottom gondola coal cars for the Chesapeake & Ohio. As these cars were not duplicates of any previously built cars, it was necessary to prepare new designs in order to incorporate the general features specified by the railway company. This work was



Striking Casting and Drawbar Carrier Are Combined in a Single Steel Casting

done under the direction of S. B. Andrews, afterwards appointed mechanical engineer of the Chesapeake & Ohio.

While the Newport News Shipbuilding & Dry Dock Company already had carried on successfully the general overhauling of locomotives and had rebuilt a considerable number of freight cars, the construction of new cars in 1923 was not begun until the problems involved had been given careful consideration and the plant prepared to undertake the work. Shops were re-arranged, with the existing machines suitably placed or new machines purchased and installed for the orderly movement of materials from receiving platform to assembly tracks.

All work was jigged and every precaution taken to insure interchangeability of sheets and parts in order to facilitate erection, which was carried on by the most approved station to station system. The building of this lot of cars was completely scheduled and consequently the work was carried on as a strictly manufacturing proposition. The success of the manner in which the design was prepared and the cars constructed demonstrates the careful and thorough manner in which car building was considered.

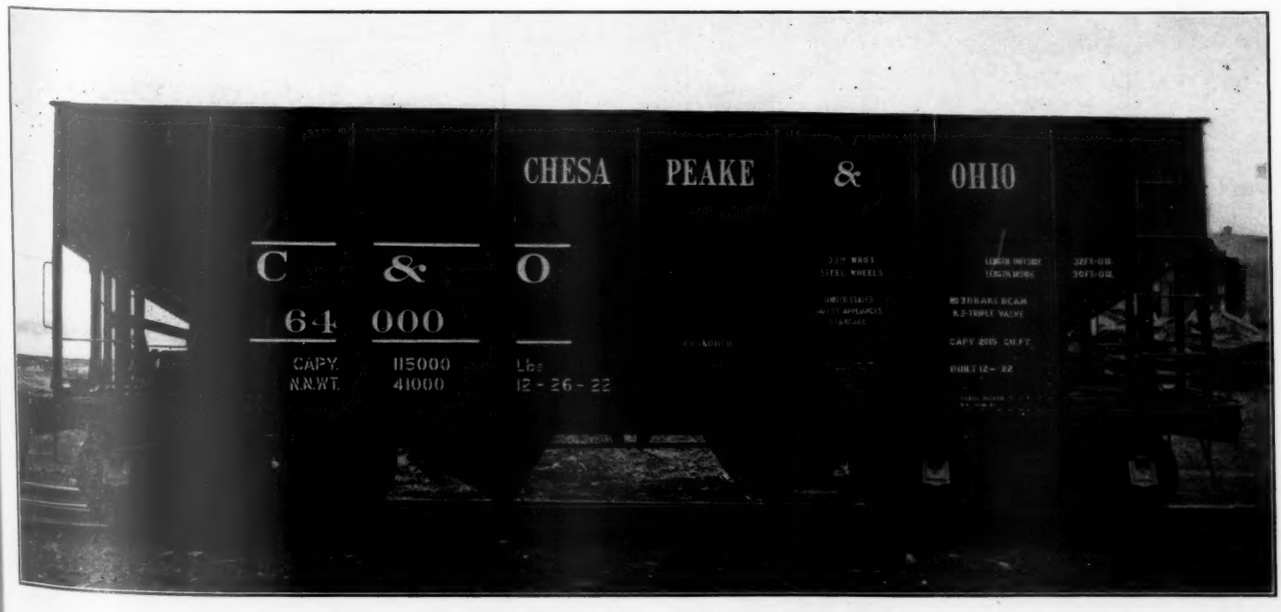
These cars represent the best and most modern features of car construction. As the tonnage of the trains operated on the C. & O. is unusually heavy and as a large number of 70-ton and 90-ton cars are in use, the cars are subjected to severe strains.

The experience of the railroad with cars previously built indicated the possibility of certain improvements that would add to the strength and durability. After a thorough investigation, the new design was prepared and a number of modifications incorporated.

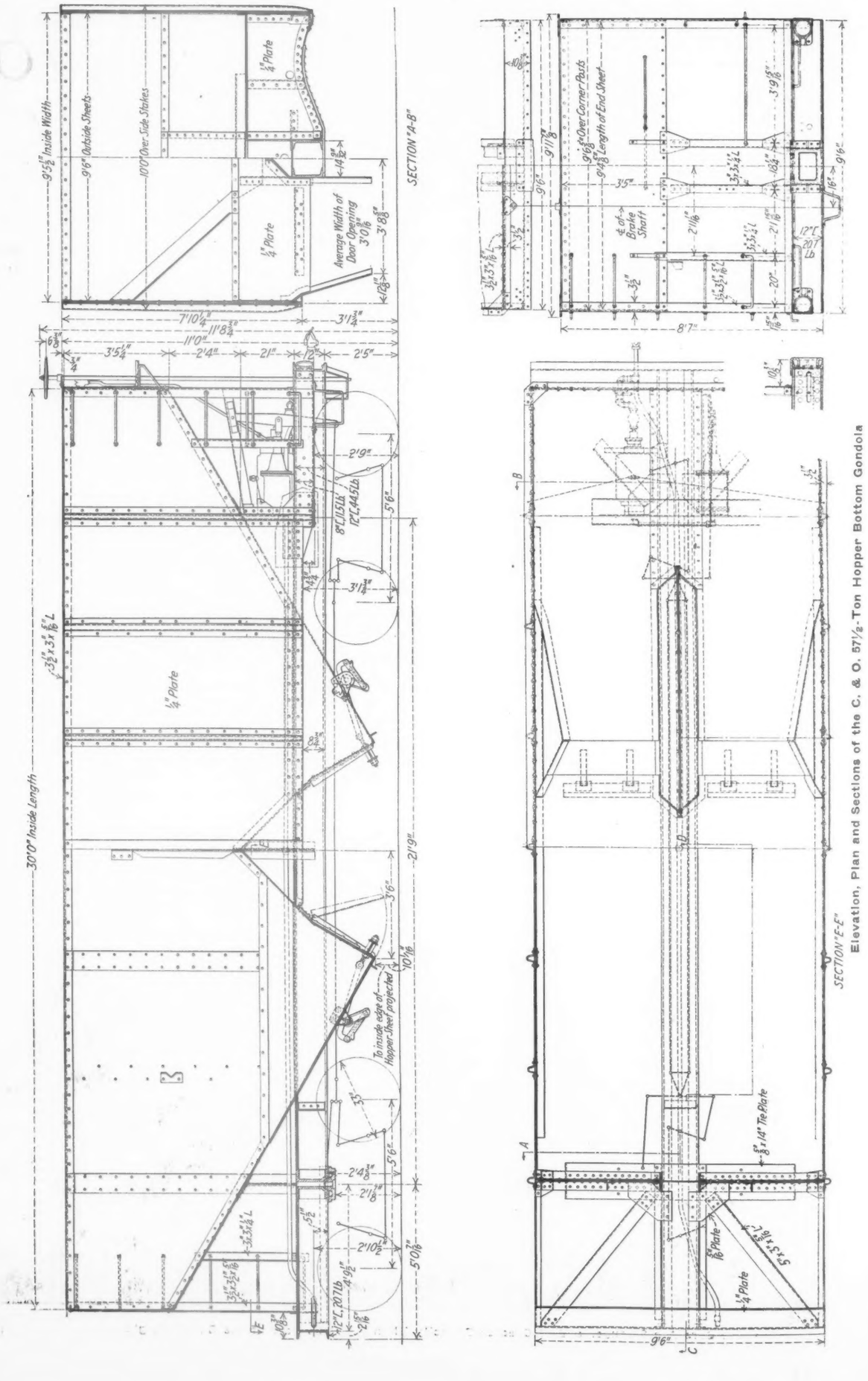
Heavy Sills and Substantial Draft Gear Attachment

Particular attention was given to the strength of the center sills and the construction of the draft gear attachments. In place of following the usual practice of using center sills of 12 in. or 15 in. in depth, weighing from 33 lbs. to 35 lbs. per foot and reinforced by angles riveted to the bottom of the sills, these cars have 12-in. channel iron sills, weighing 44.3 lbs., which are sufficiently heavy not to require reinforcing angles.

Advantage was taken of the thicker webs of the sills in providing additional bearing area for rivets and the draft stops were attached by 1⅛-in. rivets in place of ⅞-in. rivets, which is the almost invariable practice. In using the smaller rivets, made necessary by the thinner webs of older designs,



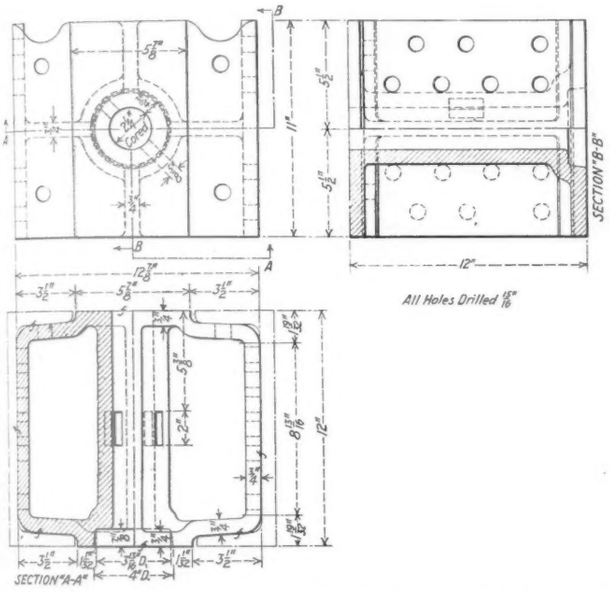
These Cars Are Stronger and of Greater Capacity Than Previous Cars of the Same Weight



Elevation, Plan and Sections of the C. & O. 57½-Ton Hopper Bottom Gondola

it was realized that with all the rivets possible to be applied, the draft gear attachment was not as strong as desirable. The use of the larger rivets results in a very substantial improvement in this respect, while the number of rivets is reduced.

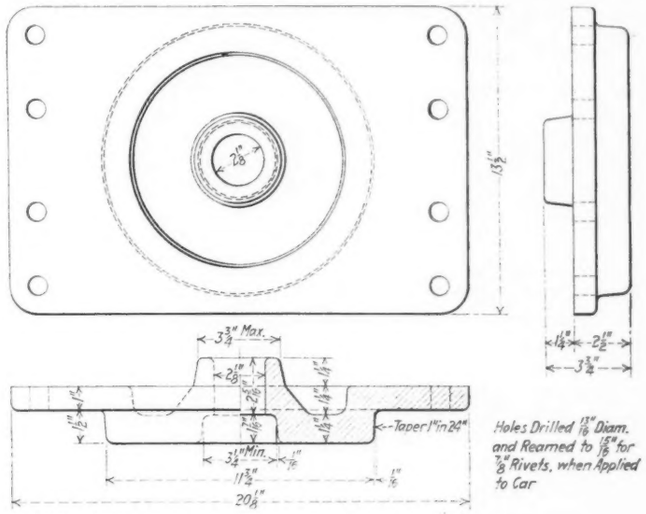
Most hopper cars have end sills much lighter than the center sills and in many designs the end sill is considerably weakened by the cut out made for the drawbar. In this design, the end sill is of the same depth as the center sills and is located on the same level. A rectangular cut through the middle of the web for the drawbar does not appreciably weaken the end sill, however, the striking casting and the drawbar carrier are combined in a single steel casting, which fits between the flanges of the end sill and bears against the web, which, in turn, has a full bearing over the entire end faces of the center sills.



The Body Bolster Center Brace Is Machined to Fit Sills and Plates

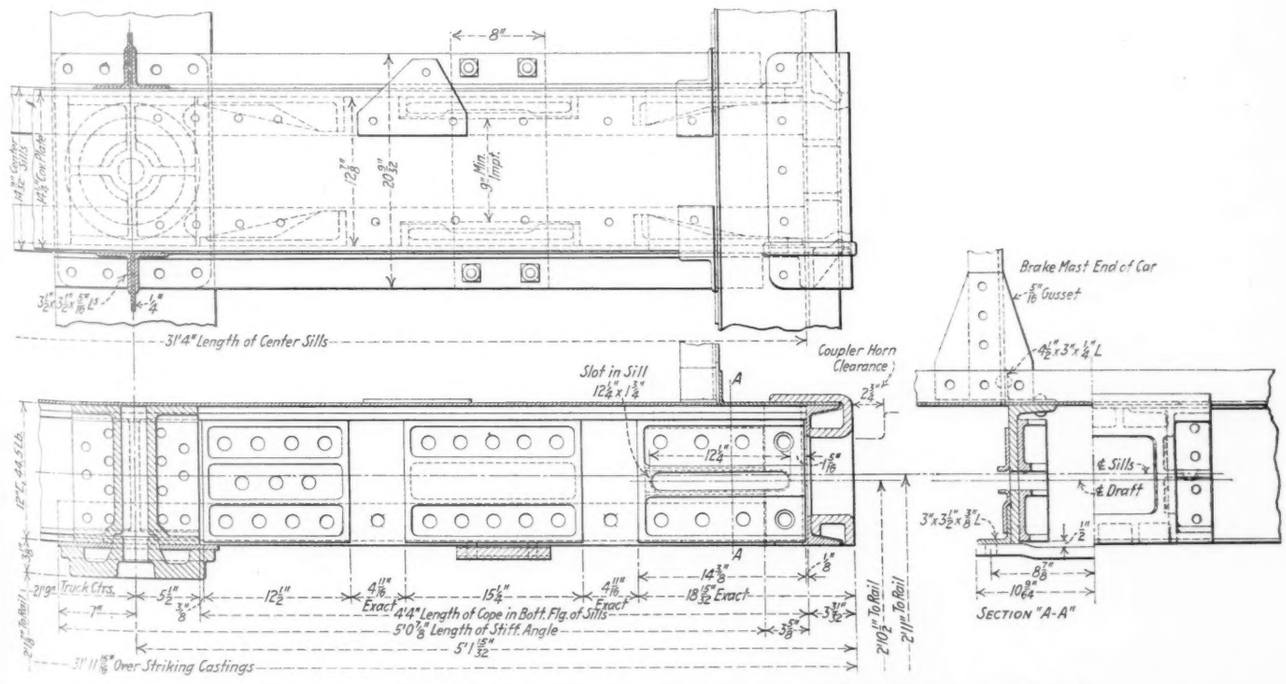
Center Plates and Bolster Brace

The experience of the railway with previous designs indicated that stronger center plates and a better support for the center plates was desirable. The center plates on these cars are drop forged and are heavier than is the usual practice, being 1¼ in. thick over the bowl, and are securely anchored by extending up into the center brace.



Center Plates Are Drop Forged and Unusually Heavy

The weight of the car is transferred from the body bolster to the center plate through a cast-steel center brace, which was accurately machined to fit between the flanges of the


31'4" Length of Center Sills
Coupler Horn Clearance
Slot in Sill
Brake Mast End of Car
5/16" Gusset
℄ Sills
℄ Draft
4'4" Length of Cope in Bott. Flg. of Sills
5'0 7/8" Length of Stiff. Angle
5'1 15/32" Over Striking Castings
SECTION "A-A"

Center Construction from Bolster to End—Center Stop Lugs Come Into Use When Gear Goes Solid

center sills and also against the top bolster cover plate and center plate.

These cars are another step in the direction which car design has been progressing steadily since steel freight cars

came into common use, that is to build stronger and more substantially.

Below is given a comparison of the sills on three similar hopper bottom gondola cars of different ages, all built in the past few years. The oldest, built in 1912, is a good average example of a design used generally at that time. The next car is the car designed by the U. S. R. A. and built in 1919. The last represents the cars built at Newport News in 1923.

COMPARISON OF SILLS IN DIFFERENT DESIGNS

	55-ton 1912	55-ton U. S. R. A.	57½-ton Newport News
Sills	15 in.—35 lb.	12 in.—23 lb.	12 in.—44.3 lb.
Area center sills	18 sq. in.	25.5 sq. in.	31 sq. in.
Ratio end stress to end load	.133	.0512	.0486
Draft stop rivets	24—⅞ in.	44—⅞ in.	38—1⅛ in.
Rivets, area	16.57 sq. in.	30.37 sq. in.	42.09 sq. in.
Rivets, bearing	9.675 sq. in.	19.387 sq. in.	32.21 sq. in.

Center Draft Gear Stops

In addition to the usual front and rear draft gear stops, these cars have center stop lugs which come into use when the gear goes solid. These are secured by 20 1⅛-in. rivets, which adds very substantially to the values given in the table.

In order to resist the effects of corrosion, all the plates ¼-in. or less in thickness, are of copper bearing steel.

The trucks are of the Andrews type with Bettendorf cast steel side frames, U type, with integral journal boxes. They have Simplex truck bolsters; A. R. A. class D double coil truck springs; A. R. A. No. 3, 18,000 lb. brake beams; and 33-in. diameter wrought steel wheels.

The cars also are equipped with Symington door operating mechanism; A. R. A. type D couplers, with 6-in. by 8-in. shanks; Westinghouse type D-3 friction draft gear, and Westinghouse schedule KD-1012 air brakes.

The general dimensions of the three designs are shown in the table.

	55-ton 1912	55-ton U. S. R. A.	57½-ton Newport News
Length over striking castings	31 ft. 6 in.	31 ft. 11 in.	31 ft. 6 in.
Length inside body	30 ft. 0 in.	30 ft. 6 in.	30 ft. 0 in.
Width over side stakes	10 ft. 0 in.	10 ft. 1 in.	10 ft. 0 in.
Width inside car body	9 ft. 5½ in.	9 ft. 5½ in.	9 ft. 5½ in.
Height from rail to top of body	10 ft. 0 in.	10 ft. 8¼ in.	11 ft. 0 in.
Height from rail to top of brakemast	10 ft. 9¾ in.	.....	11 ft. 9¼ in.
Distance center to center of trucks	21 ft. 9 in.	21 ft. 11 in.	21 ft. 9 in.
Truck wheel base	5 ft. 6 in.	5 ft. 6 in.	5 ft. 6 in.
Size of journals	5½ ft. 10 in.	5½ ft. 10 in.	5½ ft. 10 in.
Type of truck	Arch bar	Andrews	Andrews
Coupler shank	5 in. by 7 in.	6 in. by 8 in.	6 in. by 8 in.
Cubical capacity	1,731 cu. ft.	1,880 cu. ft.	1,955 cu. ft.
Light weight	36,000 lb.	40,750 lb.	41,700 lb.

Gaging Wrought Steel Wheels for Car and Tender*

Discussion on Use of New A.R.A. Steel Wheel Gage for Determining Defects, Turning Wheels and Billing

By Arthur Knapp
Assistant to Consulting Engineer, New York Central

As we consider the change in practice required by the new rules of the American Railway Association, it will be necessary thoroughly to understand some of the terms used in referring to certain portions of the wrought steel wheel rim, for example: front face, back face, measuring line, rim thickness, and interior diameter, (front and back) as illustrated in Fig. 3.

Effective March 1, 1924, the "limit of wear groove" cut on a line ¾ in. from the inner edge of the *front face of the rim* of all wrought steel wheels will be disregarded in taking measurements to determine rim thickness.

Effective January 1, 1924, all measurements involving the thickness of the rim of wrought steel wheels must be taken on the *back face of the wheel rims* so as to determine the thickness of the rim between the *inside edge of the back face of the rim* and the line on the tread at which a line drawn through the intersection of the line *A-B* and the tread of the wheel, parallel to the axis of the wheel, meets the *back face of the wheel rim*. This measurement must be taken with a standard A. R. A. steel wheel gage or a gage of similar type approved by the A. R. A. to conform with the A. R. A. Interchange Rules effective March 1, 1924, Fig. 3.

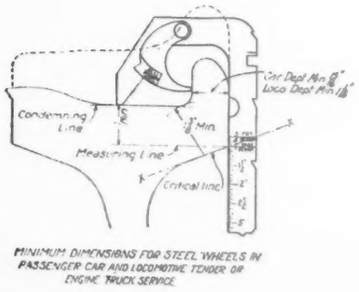

Car Dept. Min. ⅞"
Loco. Dept. Min. 1"
Condemning Line
1" Min.
Measuring Line
Critical line
MINIMUM DIMENSIONS FOR STEEL WHEELS IN PASSENGER CAR AND LOCOMOTIVE TENDER OR ENGINE TRUCK SERVICE

Fig. 1A

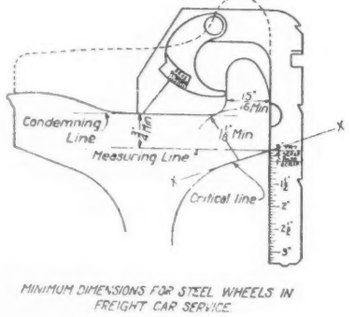


Fig. 1B

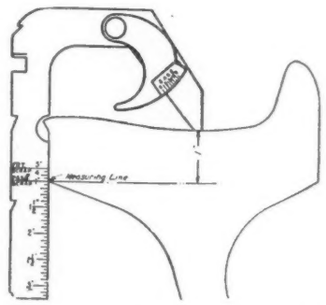


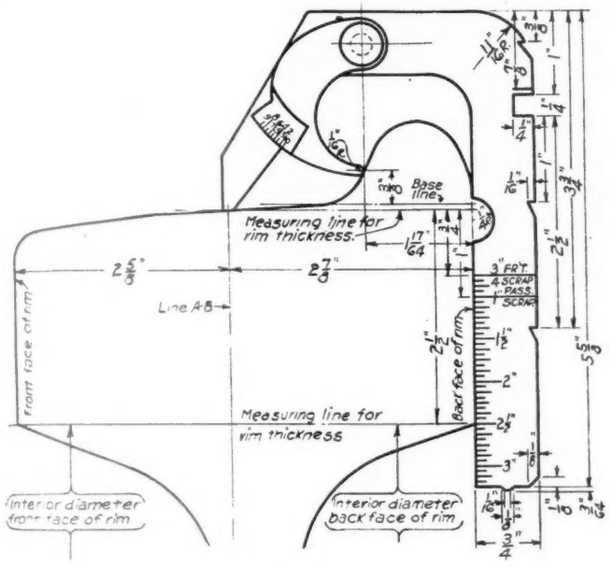
Fig. 2

Effective March 1, 1924, the condemning limit for rim thickness for wrought steel wheels used in passenger car, locomotive tender and engine truck service will be 1 in., Fig. 1A. The condemning limit for rim thickness for wrought steel wheels used in freight car service on all axles up to and including "E" axle with a 6 in. by 11 in. journal will be ¾ in., Fig. 1B. These condemning limits are indicated on the long leg of the A. R. A. gage by two horizontal

*Abstract of a paper presented at the December meeting of the Car Foremen's Association of Chicago.

lines. A line to indicate the condemning limit for passenger car, tender and truck wheels is marked *"passenger scrap,* 1 in." and the line to indicate the condemning limit for wheels used in freight service is marked *"freight scrap,* ¾ in."

The Wheel Committee considered the difficulty that might be experienced in attempting to apply the standard steel wheel gage to the back of the flange of wheels in the middle


Base line
Measuring line for rim thickness
Line A-B
From face of rim
Back face of rim
Measuring line for rim thickness
Interior diameter front face of rim
Interior diameter back face of rim

STEEL WHEEL GAGE

For use in measuring tread thickness amount of metal to be turned off tread to restore flange contour, and limit of depth and location of witness groove in flange, slid flat spots, vertical flanges, chipped rims and axle collar thickness.

Fig. 3—A. R. A. Standard Gage for Wrought Steel Wheels

of a 6-wheel truck, and it is therefore designed so that it may be applied when occasion requires to the front face of the rim (Fig. 2); but the rules specify that the final measurements for rim thickness must always be taken on the back face of the rim.

New York Central Practice

The instructions issued to all New York Central shops in connection with the changes effective January 1 require that the standard steel wheel gage must be used without exception to determine:

1. Whether worn steel wheels removed from any class of service should be—(a) Turned and re-applied to passenger car or engine tender or truck service. (b) Condemned for passenger car or engine tender or truck service but set aside for the reclamation for use in freight car service. (c) Condemned for all service and scrapped.

2. The amount of metal it will be necessary to turn from tread and flange contour.

3. The amount of metal that will remain for service after turning.

The application of the gage to a worn flange of a steel wheel will be indicated, as illustrated in Fig. 4, the gage to be applied at two or more points to determine the point of greatest flange wear. The reason for this requirement is the variation in flange thickness disclosed during experiments with the steel wheel gage.

To determine rim thickness and amount of metal it will be necessary to remove from the tread to restore a standard tread and flange contour, the long leg of the gage must be applied *snugly* against the *back face of the rim,* and the short leg must rest on the tread of the wheel. The reading on the long leg at the point of intersection with the underside of the rim will indicate the over-all rim thickness. The moving finger on the short leg must then be adjusted until the point rests against the face of the flange. The graduation on the moving finger nearest to the point of intersection between the scale on the finger of the gage and the short leg represents the number of sixteenths to be removed from the wheel tread to restore a standard tread and flange contour with a witness mark in the face of the flange within the prescribed limits. The rim thickness of the wheel *after turning* may be determined *before turning* by subtracting the reading on the graduated finger of the gage from the scale reading on the long leg; for example, in illustration, Fig. 4, the scale on the long leg intersects the measuring line at 1-13/16 in. which is the rim thickness over all. The position of the gage finger indicates it will be necessary to remove 7/16 in. of metal to restore tread and flange contour. Deducting 7/16 in. from 1-13/16 in. gives 1⅜ in., which represents the rim thickness that will remain after the wheel is turned. As the condemning limit for rim thickness for passenger car, engine tender and truck service is 1 in., ⅜ in. of metal will be available for service after turning. If the wheel is to be applied to a freight car, the metal available for service after turning will be ¼ in. additional. Rule 101 of the A. R. A. indicates the value of each 1/16 in. of metal available for service in the rim of a wrought steel wheel applied to freight car service as $1.52; and the value of each 1/16 in. of metal available for service in the rim of a wrought steel wheel applied to passenger car service is $2.04. These prices may be modified somewhat for 1924.

All concerned in the turning, mounting, and re-application of wrought steel wheels should use good judgment to avoid unnecessary waste of service metal. Instructions issued to New York Central shops require the use of the steel wheel gage for all calculations and operations incident to turning wrought steel wheels and require that the following practice be carefully observed.

1. When the point of intersection between the finger and the short leg of the gage is between two graduations, the

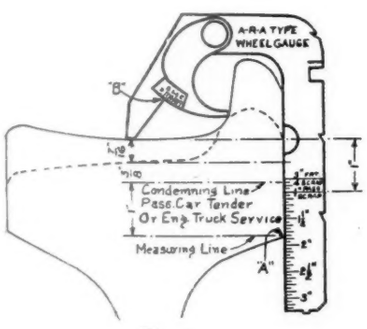
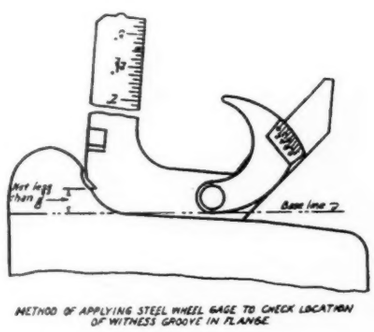
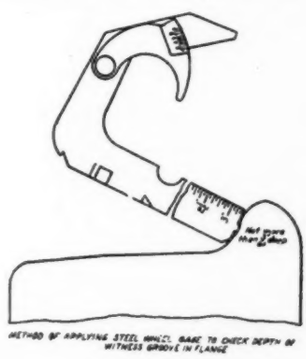


Fig. 4



METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK LOCATION OF WITNESS GROOVE IN FLANGE

Fig. 5



METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK DEPTH OF WITNESS GROOVE IN FLANGE

Fig. 6

lowest reading must be taken as the basis for turning operation.

2. Deduct at least 1/16 in. from the gage reading so obtained to establish the depth of the rough cut and use the finishing tools to remove such additional metal from tread and flange as may be necessary to obtain a standard contour. A witness mark should appear on the face of the flange of every wheel turned on account of flange wear as proof of good workmanship. The lower edge of such witness mark must be at least 3/8 in. above the tread. The width of the mark should not exceed 3/8 in., and the depth must not exceed 3/64 in. The location and depth of witness mark must be checked by application of the gage as illustrated in Figs. 5 and 6.

The loss in service metal involved in restoring a standard tread and flange contour of a worn wheel is greater than that involved in any other wheel turning operation; for example, when the flange thickness is reduced to 15/16 in., 1/2 in. must be removed from the tread to restore a full flange. Usually the mate wheel is in such condition that a standard tread and flange may be restored with a loss of 1/8 in. or 3/16 in. service metal. Frequently this waste may be avoided by dismounting, remating and remounting flange worn wheels, and we have recommended a study of shop conditions to provide facilities when such practice will result in a saving of service metal with a value in excess of the cost of the operation. Twelve pairs of flange worn wheels recently removed from service for turning in one N. Y. C. shop were measured with the A. R. A. steel wheel gage and then were dismounted, remated and remounted to avoid unnecessary waste of service metal. The average saving was 5/16 in. per pair of wheels, representing a saving of approximately $9.00 per pair after deducting the cost for dismounting, remating and remounting.

When wheels are sent to the shops for turning on account of shelled spots in the treads, the depth of the defect should always be determined by a rough cut before an attempt is made to turn both wheels to an equal diameter for re-application. Frequently shelled spots require a cut of 1/2 to 3/4 in.; and if both wheels are turned, a serious loss is involved in connection with the reduction in rim thickness of the sound wheel mated with the defective wheel.

A. R. A. Rules require the use of the wheel gage to determine the amount of metal charged to a delivering line in connection with wheel turning to correct slid flat spots. The method to be used is illustrated by Figs. 7 and 8. Fig. 7 shows the gage applied at the center of a slid flat spot, and Fig. 8 shows the gage applied at some other point on the tread. The scale on the long leg, Fig. 7, indicates the over-all rim thickness as 1-7/16 in., and the scale on the long leg, Fig. 8, indicates the over-all rim thickness as 1-9/16 in. In this illustration 1/8 in. (the difference between the two readings) plus 1/16 in. of tread metal must be charged to the delivering line on account of the slid flat spots, and 1/4 in. must be charged against the owning line on account of restoring flange contour. The extra 1/16 in. charged for the flat spot is made to allow for cutting under the hard surface in the center of all slid flat spots.

The gage may also be used to determine: (a) The length of slid flat and shelled spots—wrought steel, cast steel, or cast iron wheels, as indicated in Fig. 9. (b) Flange wear and vertical flanges: Rule 74 in the Code of Rules will be revised to read as follows:

Worn Flanges—Cast Iron Wheels: Under cars of less than 80,000-lb. capacity with flanges having flat vertical surface extending 1 in. or more from the tread, or flanges 15/16 in. thick or less, gaged at a point 3/8 in. above the tread.

Wheels under cars of 80,000-lb. capacity or over, with flanges having flat vertical surface extending 7/8 in. or more from tread, or flanges 1 in. thick or less, gaged at a point 3/8 in. above the tread.

Worn Flanges—Wrought Steel, Steel Tired, or Cast Steel Wheels: Flanges having flat vertical surface extending 1 in. or more from tread, or flanges 15/16 in. thick or less.

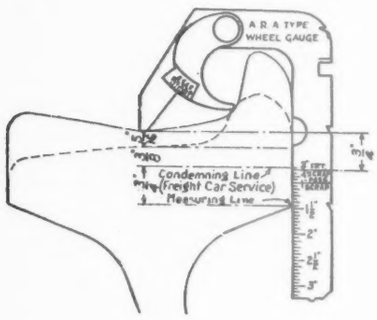


Fig. 7

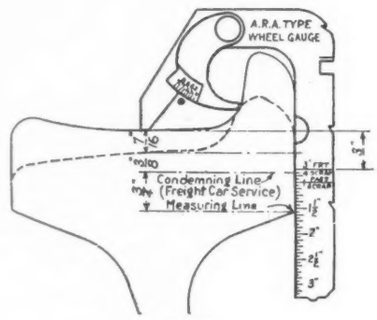


Fig. 8

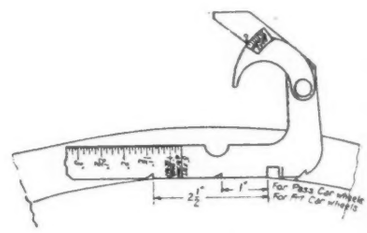


Fig. 9

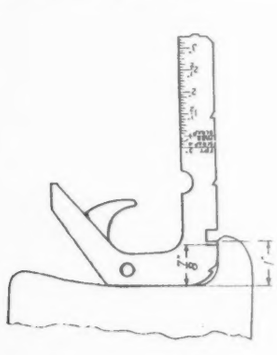


Fig. 10

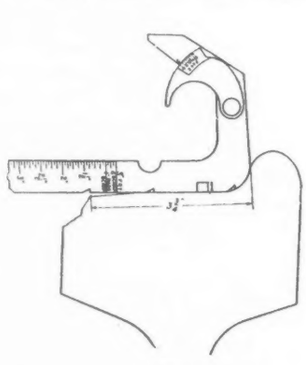


Fig. 11

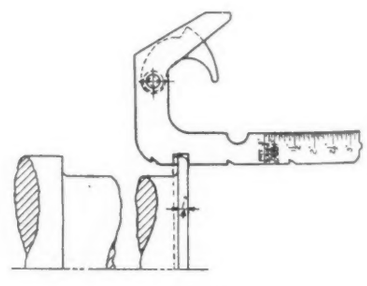


Fig. 12

The use of the gage to determine height of flange is illustrated by Fig. 10, and flange thickness may be determined on steel wheels by setting the finger at graduation No. 8.

(c) Rule 72 will be revised to describe a chipped rim as "Any circumferential seam within 3¾ in. limit from flange. This may be determined by applying the gage as illustrated in Fig. 11.

(d) The application of the gage to determine limit of wear on journal collars is illustrated by Fig. 12.

(e) Coupler wear may be checked when necessary by shortening the leg 5⅛ in. It will be understood, however, that this will shorten the scale on the leg and the gage should not be mutilated if there is any liability that it will be required for use in turning operations.

As the condemning limits for rim thickness effective January 1, 1924, for wrought steel wheels in freight car service will be ¾ in. for all axle sizes up to and including the 6 in. by 11 in. journal, a large percentage of the wheels removed from passenger car and tender service may be re-turned and re-applied under freight cars, provided removal from service is not occasioned by a defect that would render the wheel unfit for further service.

Experiments indicate that wheels reclaimed may be used to the best advantage when remated and remounted on axles with 5½ in. by 10 in. journals for application under 100,000-lb. capacity cars. To avoid unnecessary dismounting and remounting, all wheels removed from either passenger car or tender service on 5½ in. by 10 in. or 6 in. by 11 in. axles, should be held on such axles for re-turning for application to freight service, provided both wheels of the pair will turn with at least ⅛ in. to 3/16 in. service metal available for freight service.

When one wheel of a pair of wheels mounted on a 5½ in. by 10 in. or 6 in. by 11 in. axle will not turn with the required amount of service metal over the proposed ¾ in. condemning limit, then both wheels should be dismounted to release the axle for further service.

All wheels mounted on axles with journal sizes less than 5½ in. by 10 in. should be dismounted at point of removal and axles released for other service.

Prior to remounting, all wheels must be inspected to eliminate defective wheels and to avoid mating wheels which will not turn to equal diameters with approximately the same amount of service metal after turning. The general rule should require that all wheels suitable for re-turning for re-application to freight service be assembled at some shop properly equipped for the various operations involved. All wheels mounted on 5½ in. by 10 in. or 6 in. by 11 in. axles to be shipped as removed from service; all others to be dismounted and shipped as loose wheels in carload lots.

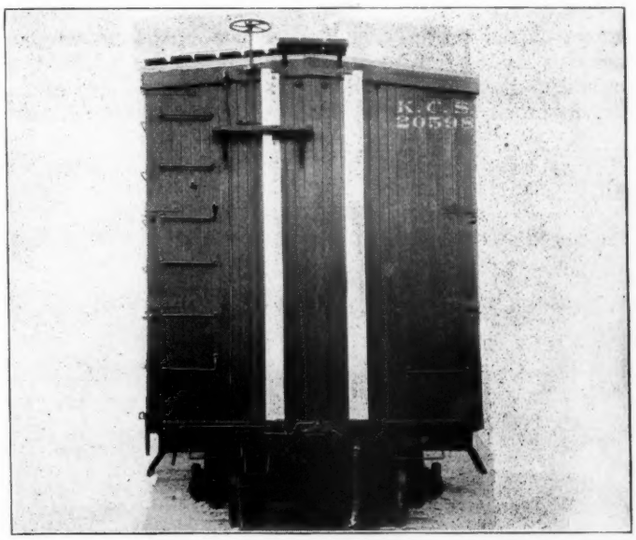
Norfolk & Western Practice

There is one feature not mentioned in the paper in particular, and that is the man in charge of the reclaiming process. He may have several carloads of wheels. The wheels will vary in diameter and rim thickness, the flanges will be thick and thin. He will have to remate those wheels and remount them on an axle and send them to be turned. Now, if he mounts a 33 in. wheel and a 36 in. wheel with the same rim thickness together on the same axle, the mounting operation will be a loss even though he turns them down together. The N. & W. have been following this practice of remating and remounting wheels for a number of years. Their Mr. Cook has worked out a table of tape sizes and variations in the rim thickness, which I believe is copyrighted. This can probably be obtained by writing to Bernard Cook, assistant engineer of tests, Norfolk & Western, Roanoke, Va. I refer to that table because at one time it was presented to the Wheel Committee and shortly afterwards recalled by the superintendent of motive power of the N. & W. with the statement that Mr. Cook desired to copyright it. We have prepared tables for the N. Y. C. which show the reduction in tape size on wheels based on the reduction in rim thickness. I have not incorporated that table in the paper, however, because I believe the simplest way is to base the necessary calculations on a reduction of three tapes in tape size for each 1/16 in. rim thickness. In other words, two wheels may be presented to the man who is handling the work. One wheel may be 1 5/16 in. rim thickness, tape 155, and require a 5/16 in. cut in the lathe. The other wheel rim may be 1½ in. thick, tape 166, and require a ½ in. cut in the lathe. Based on three tapes reduction in tape size for each reduction of 1/16 in. in rim thickness will reduce the first wheel 15 tapes, or from tape 155 to tape 140. The other wheel, with 1½ in. rim thickness, tape size 166, and requiring a cut of 8/16 in., will be reduced 24 tapes, or to tape 140. The wheels may therefore be pressed on the axle and placed in the lathe, notwithstanding the difference in rim thickness and tape size, and both wheels will be turned to tape 140.

(*An abstract of the discussion which followed the reading of Mr. Knapp's paper will appear in the next issue.*)

Automobile Car End Doors Removed*

IN 1913 the Kansas City Southern purchased 100 automobile cars, Series 20,500 to 20,599, with large doors in one end of each car to permit the unloading of automobiles from the ends as well as the sides. After the cars were in service a year or more it was found that these large end doors were very expensive to maintain and that little use was made of them, the majority of the automobiles being unloaded and loaded from the large double side doors. It was found that



K. C. S. Automobile Car with New Mogul End in Place of the Original Doors

the end doors could not be kept fastened and frequently hung out over the couplers, violating the end ladder clearance law and continually resulting in safety appliance defects which caused the cars to be sent to the rip track for adjustment. It was also found that a lack of posts and bracing in the ends caused the cars to weave considerably, which damaged the roofs and superstructure.

A design was, therefore, developed to eliminate the doors

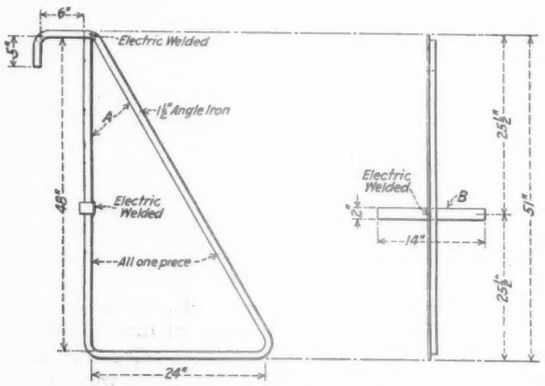
* This article was prepared from data furnished by M. A. Hall, superintendent machinery, and published in the December 15, Mechanical Department Bulletin, of the Kansas City Southern.

and replace them with Mogul ends to both ends of the car and to provide a better roof construction. Thirty of the cars were thus equipped in 1923.

The appearance of these cars in their present condition is shown by the illustration, in which the Mogul end and roof are painted white to show the elimination of the end door and the application of the new roof.

A Platform Bracket for the Steel Car Shop

A DEVICE used for holding a scaffold on the side of a hopper or gondola car, is shown in the sketch. A 1½-in. by ⅛-in. angle, 11 ft. 8 in. long, is bent into the form of a bracket and welded at the top. A cross piece, *B*, 2 in. by ½ in. and 14 in. long, is welded 25½ in. up from the



Bracket for Holding Scaffolding on the Side of a Car

bottom on the vertical side. As shown in the illustration, the ends of the crosspiece are bent in such a manner as to hold the bottom of the bracket away from the side of the car, in order to keep the floor of the scaffold level. Its

The Bracket Permits Sufficient Head-Room for a Man to Work Underneath

light construction makes it easy to move from one car to another and has been found to be a labor saver.

This bracket is intended to displace the wooden horse usually used in a car shop. It is hung over the side of the car and a couple of planks are laid on the horizontal side or bottom leg of the bracket. This arrangement does not take up the floor space formerly occupied by the horses and permits greater freedom of movement in handling material around the cars. The brackets are so designed that the scaffolding can be run the entire length of the car and also allows a clear passage underneath.

Recent Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Car of Light Construction Damaged in Switching Movement

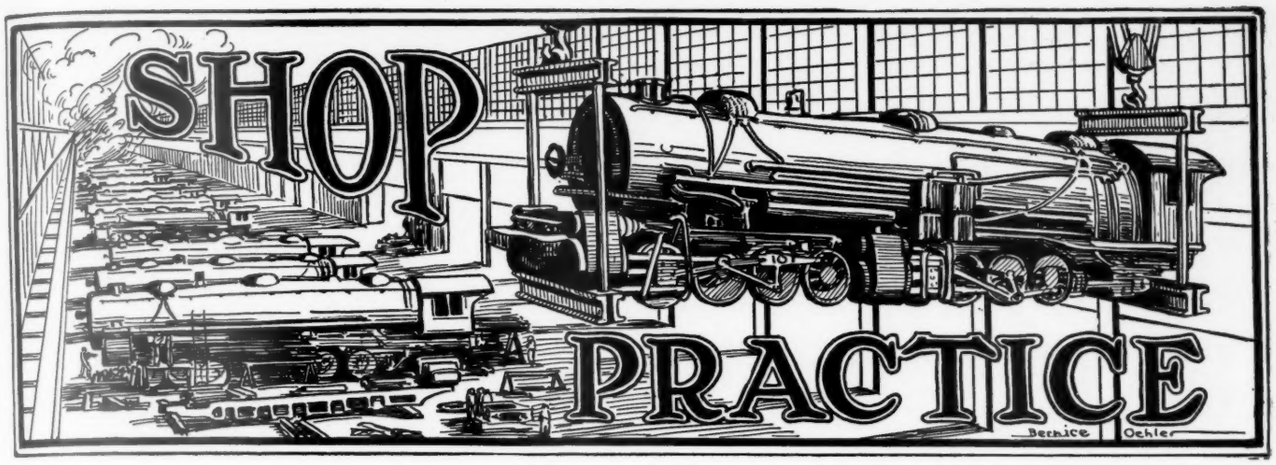
On July 25, 1922, the Fred R. Jones Company's car No. 132 was damaged while being handled in a switching movement at Canton, Ohio. This car, a wooden box car of 50,000 lb. capacity, was one of 30 other cars that were being transferred to the Wheeling & Lake Erie. It was of light construction, and in the attempt to start the train, the sill and draft rigging were pulled out on the *B* end of the car. The Wheeling & Lake Erie made an inspection and found that the damage was due to a decayed end sill, and on account of the light construction and age of the car, which was approximately 30 years old, it could not stand the strain. The owner refused to accept the report of the inspectors and contended that the damage resulting to this car was caused by rough handling on the part of the Wheeling & Lake Erie. It claimed that the handling line should be held responsible as the car was fit for service at the time it was loaded with tools at Canton, Ohio.

The Arbitration Committee rendered the following decision: "The contention of the Wheeling & Lake Erie is sustained."—*Case No.* 1281, *Fred R. Jones Company vs. Wheeling & Lake Erie.*

Another Case Under Rule 32

The Louisiana Railway & Navigation Company's car No. 5530 was damaged while being switched on the lines of the St. Louis-San Francisco. The handling line claimed that this car was being switched on a level grade and under the circumstances, did not require rider protection. Furthermore, its records showed that the speed of the car at the time of the accident was only four or five miles an hour, which, it contended, is the average normal speed for switching service. This car was of wooden construction of 60,000 lb. capacity and was equipped with metal draft arms extending beyond the body bolster. On January 27, 1922, the handling line presented a bill to the owner, of $272.91, claiming that the car was defective and had not been subjected to unfair usage. The owner claimed that rider protection should have been furnished. It also contended that the switchman found a defective brake ratchet on one of the cars being handled with this car and that this charge should have been rendered in conformity with Rule 120, which makes a limit of $270 for the repair of steel underframes.

The Arbitration Committee decided that the car was not subjected to any unfair usage within the intent of Rule 32, and that the owner was responsible.—*Case No.* 1280, *St. Louis-San Francisco, vs. Louisiana Railway & Navigation Company.*



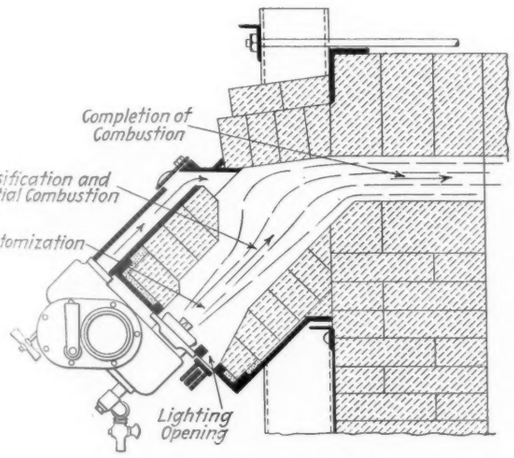
The Correct and Incorrect Use of Fuel Oil*

Marked Economy Effected by Correctly Designed Burners and Furnaces—Quality of Work Improved

By H. A. Anderson
Chief Engineer, Mahr Manufacturing Company

FUEL oil or liquid fuel is one of the fuels most abused because it is so exceedingly easy to build a device that will produce heat. The device may be very inefficient, but by a reckless use of oil, fair results may be obtained.

The term "oil burner" is a misnomer. A great multitude of burners are merely atomizers, spraying the oil into the furnace. The furnace in this case must mix, gasify and burn the fuel. A burner cannot be rightfully called a burner unless it actually completes the combustion of the fuel with out external aid; that is, it must be independent of the furnace.



A Closed Type Combustion Burner

The function of the furnace is not to burn the fuel but to conserve and distribute the heat developed by the burner. The test of a real burner is its ability to completely burn the fuel without being applied to a furnace. To meet these requirements, it must not only atomize the fuel completely, but thoroughly mix the finely divided oil with the correct amount of air. It must then gasify the finely divided particles of oil and completely burn the gas. The gasification and combustion of the finely divided fuel must take place in a small space under high temperature, in order to obtain perfect combustion.

The Four Types of Burners

Liquid fuel burners may be divided into four groups—the vapor, mechanical, spray, and combustion type burner. The vapor burner passes the fuel through or over a hot surface so as to convert the oil to a vapor or dry gas. This vapor is then passed through a nozzle or allowed to escape from the hot surface and mix with atmospheric air. This air is usually induced into the furnace by stack draft. Frequently a small blower is used to aid the stack draft. This type of burner will only operate on the light fuels, such as kerosene, distillate and some grades of furnace oil. Its capacity is limited by the vaporizing capacity of the hot surface over which the fuel passes. It is more or less difficult to control the temperature and atmosphere with this type of burner. The generating surfaces frequently collect carbon owing to the cracking of the fuel. This reduces the capacity of the burner and frequently clogs it up entirely. The field of this burner is limited to small capacities, for small portable torches and domestic heating. The big problem is the control of the temperature of the vaporizing surface and the proper mixing of air and vapor.

The mechanical burner atomizes the fuel by passing it through small orifices under high pressure. These orifices are usually placed tangentially to an expansion chamber so as to set up a rapid rotation. The velocity and rotation atomize the fuel and also help to mix the finely divided oil with the induced air. The air for combustion is drawn into the furnace chamber through small ports around the burner by the effect of the stack or pressure set up in the furnace room. This type of burner is almost exclusively used in the marine service because it requires very little auxiliary equipment. The first object in this service is to reduce the

*A paper presented before the Southern and Southwestern Railway Club at Atlanta, Ga., on September 20, 1923.

weight of the equipment to a minimum, in order to increase the load carrying capacity of the vessel.

The mechanical burner is not well adapted for industrial heating because the operating range is very narrow, but is suited to high capacities, such as 50 gal. per hour and over. A new type of mechanical burner recently developed is the rotating cup atomizer. The oil is fed into the rotating cup by a small stationary tube. The cup is rotated by an electric motor or by a blast of air that passes vanes on the periphery of the cup. This type of burner depends on fan and induced air for combustion.

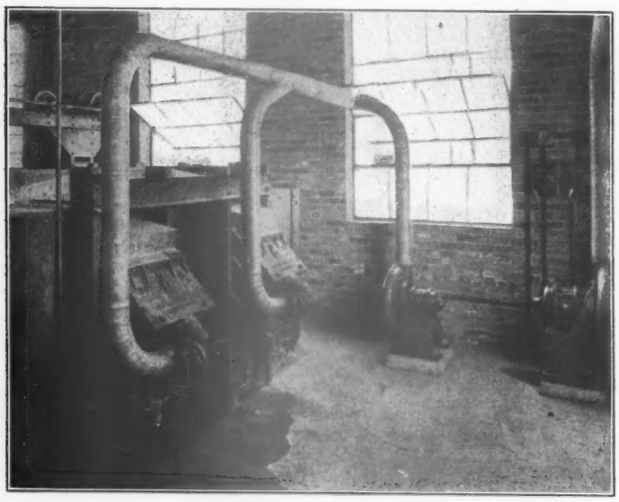
The spray burner is the atomizing device used almost universally in the industries. Atomization is accomplished by passing the oil through a nozzle in the path of a jet of air or steam. The velocity of the air or steam tears up the oil into a spray. This spray or atomized mixture is passed into the furnace for combustion. The velocity of the atomized mixture induces additional atmospheric air for combustion.

Spray type burners may be classed as follows:

1—The high pressure burner that operates on air or steam, usually between 50 and 125 lb. per sq. in.
2—The medium pressure burner that operates on air pressure at from 1 to 15 lb.
3—The low pressure burner that operates on air between 6 and 14 oz. pressure.
4—The high-low pressure burner that atomizes with high pressure air and uses low pressure air for combustion.

The closed type combustion burner operates on low pressure air between 8 and 12 oz. per sq. in. This air atomizes the fuel and also supports combustion, so that there is no induced air variable to contend with in balancing the fuel and air. This type of burner atomizes the fuel over knife edges so located in the jet of air as to thoroughly mix the fuel and air for combustion.

The first stage of combustion is gasification, or partial



Correct Installation of Low Pressure Blower Piping for Closed Type Combustion Burners

combustion; that is, burning to CO. This takes place under very high temperatures due to the small volume of the combustion chamber. The latter is lined with refractory material which is continually storing up and in turn radiating heat back to the atomized oil for gasification. A secondary supply of air is then fed into the partially burnt gases in such a way as to thoroughly mix, thus completing combustion within the burner.

The combustion type burner makes it possible to burn the fuel with practically no excess air, owing to the thorough mixing and burning of the fuel in a small space under exceedingly high temperatures. All of the fuel and air entering this type of burner is under the control of valves, hence it is easy to obtain the correct balance. The fuel being burned in a relatively small space means high temperatures and perfect combustion. This type of burner delivers a fully expanded, low velocity, hot, neutral gas to the furnace. This supply of low velocity gas readily distributes throughout the furnace. Since the combustion is complete in the burner, hot spots are eliminated in the furnace, thus increasing the life of the refractory lining.

Types of Furnaces for Spray Burners

The ordinary burner, or more properly the atomizer, being only an oil sprayer must depend on the furnace for gasification and combustion of the fuel. There are three general types of furnaces used at the present time to meet this requirement. These types are the under-fired furnace; the over-fired, checkered arch furnace, and the side trench-fired furnace.

Over-Fired Oil Forging Furnace

The under-fired furnace provides a combustion space below the furnace hearth. The burners deliver an atomized mixture to this space with induced air. A flash wall is provided in the path of the atomized mixture for mixing and reducing the velocity to a point where combustion can take place. This space below the furnace hearth must mix, gasify and burn the fuel and then deliver it to the heating chamber above. The high temperatures of combustion under the tile floor of the furnace greatly reduce the life of the tile floor. The floor in this type of furnace frequently fails during operation, dropping the complete charge into the combustion chamber. This large combustion space increases the heat loss of the furnace and also tends to reduce the efficiency of combustion. The rate of heating is comparatively slow due to the large volume of brick that must be heated by the hot gases before reaching the heating chamber above.

There are three methods of venting this type of furnace. The most common system is to place a row of vents in the furnace arch. This system vents the hottest gases from the heating chamber first, thus materially reducing the rate of heating and furnace efficiency. The rate of heating and temperature is not uniform because of a lack of circulation throughout the heating zone. The second method of venting the under-fired furnace is by vent ports in the rear wall. The location of vents in this part of the furnace tends to equalize the temperature in the rear zone of the furnace. The third system provides vents in the rear wall and door. This vent arrangement gives a fairly good circulation of heat with a small, low charge.

The over-fired checkered arch type of furnace provides a combustion space above the heating chamber of the furnace. The atomized mixture is directed against a flash wall for reducing its velocity and further mixing for combustion. The products of combustion fill this space and then escape through the many ports in the arch down to the heating chamber proper. The vents in this type of furnace are placed along the side walls at the furnace floor. The temperature in such a furnace is ordinarily uniform with small, low charges. With heavy charges there is a tendency for the heat to take the path of least resistance and flow direct to the vents, owing to the lack of a forced circulation. The rate of heating is usually slow due to the large amount of brick that must be heated in the combustion chamber above. This, in addition to the larger radiating surface, reduces the efficiency of the furnace.

The trench-fired furnace has the combustion chamber along one side of the furnace. The heat from this chamber is passed over a bridge wall to the heating chamber. The vents are generally located on the opposite side, thus carrying the hot gases over the material to be heated. This type of furnace has the same general characteristics as the under-fired furnace. The temperatures vary considerably from the bridge wall to the opposite side. The areas next to the bridge wall are frequently cold as compared with the vented side. Wide furnaces of this type are sometimes fired from both ends with vents in the arch or rear wall.

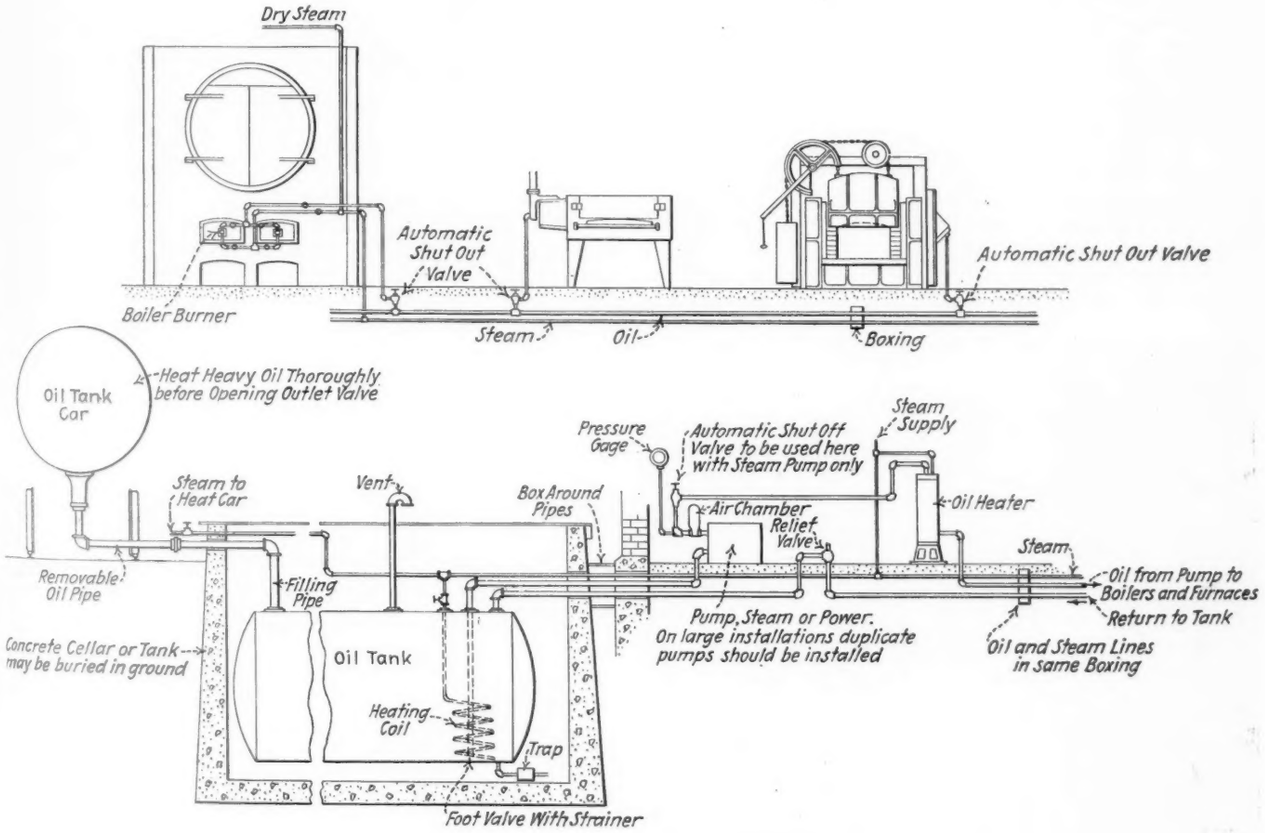
The over-fired, open chamber furnace is recognized by all as the most efficient and fastest heater. Its limitation has been the straight type of atomizing burner which depends on the furnace for combustion. Its disadvantages with the common burner are unequal heating, improper control of temperature and atmosphere, with heavy scaling and pitting of the steel.

The Combustion Type Burner

The combustion type burner has eliminated all of these disadvantages and still maintained the other advantages, such as rapid heating and high efficiency. Such a furnace of the proper design and equipped with a suitable number of combustion type burners will produce exceedingly good temperature uniformity with very close control of temperature and atmosphere. A heat treating furnace, for example, 42 in. wide, 84 in. long with a door 24 in. high will operate within 5 deg. F., plus or minus, in the heating zone. A 6 ft. wide by 14 ft. long by 3 ft. 6 in. high car type annealing furnace with a 12-ton charge will operate within 10 deg. F., plus or minus, in the same plane of the charge.

The combustion type burner is always applied to the upper zone of the furnace chamber with ample space provided above the material heated for circulation and distribution of hot gases. The vents are located close to the furnace floor so as to vent first the coolest gases from the heating chamber. The vent gases are then carried under the tile floor and up through passages in the side walls. Thorough circulation of the hot gases in the furnace with venting of the coolest gases first and then further reducing their temperature by heating the floor gives maximum heating capacity and efficiency.

The life of the furnace lining with this type of furnace is comparatively long as it is only exposed to temperatures slightly above the desired heating temperature. The life of the tile floor in the case of a heat treating furnace will be determined by actual wear of charging and discharging. The refractory lining of the combustion type burner is the only part of the furnace that will burn out and require replacement. With heat treating and annealing the life of this lining varies from one to two years. Where higher furnace temperatures are required, such as forging and welding,



Circulating System of Fuel Oil Distribution

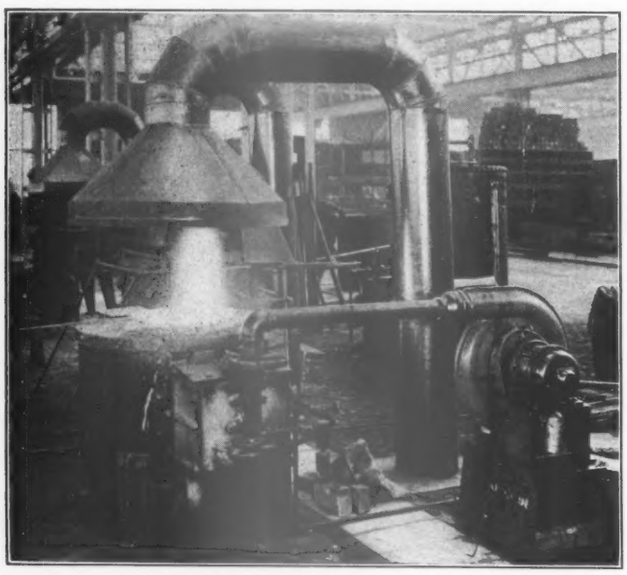
the life is from six months to one year. The combustion burner requires between 30 to 40 fire brick, which is a very small item as compared to the relining of the large combustion space in the other types of furnaces. Tile linings have been developed for the combustion type burner which again reduce the cost of replacing the burner lining.

Forging furnaces are at the present time either over-fired into an open chamber or under-fired in a similar way. The ordinary spray burner is the most commonly used. The nature of forging work is such that scaling, decarbonizing and pitting can be contended with to a certain extent without causing rejections.

Importance of Heating Chamber Design

A combustion type burner applied to a properly designed forging furnace invariably shows big savings in fuel, less rejections, better appearing material, greater output and less cost per hour and per unit produced. The heating chamber must be properly designed in relation to the combustion burner to get the best results. Tests conducted some time ago at Chicago proved this conclusively. An old furnace with high pressure burners was first tested, with an output of 49 lb. of steel per gallon of oil. The furnace design was then changed to conform with the combustion burner design and the old high pressure burner was used, with an output of 62.5 lb. per gallon of oil. The combustion type of burner was then applied with an increase to 72.2 lb. per gallon of oil. In this instance the proper furnace design showed a bigger saving than the application of the combustion type burner.

The refractory material used in the construction of a furnace also affects the efficiency, that is, the amount of

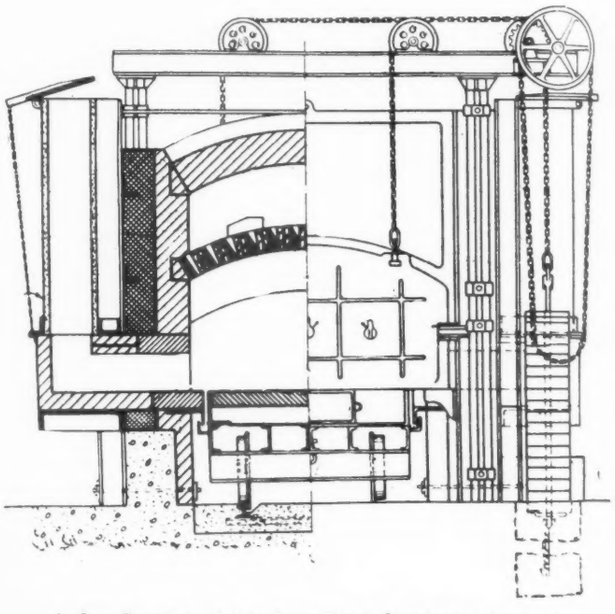


An Oil-Fired Blacksmith Forge

heat lost through the furnace walls. Ordinary fire brick has a certain insulating as well as refractory property. This insulating property is measured in terms of the number of B.t.u. that one square foot of surface one-inch thick will conduct per degree difference in temperature per hour. This unit is known as thermal conductivity. The thermal conductivity of the average fire brick is between 10 and 12. There are other insulating bricks available for further reducing the furnace losses. This brick is not a refractory and, therefore, it must be placed back of the fire brick. The average thermal conductivity of this class of brick is about one; that is, a wall 1 inch thick of insulating brick is equal to about 10 inches of fire brick.

Insulating brick pays the biggest returns on furnaces that are operated continuously. Furnaces used for a few hours each day will show no savings with insulating brick, because the heat would probably only penetrate the fire brick in that period. Therefore, the insulating brick would have no flow of heat to resist. Furnaces used for very high temperatures, such as welding, should not ordinarily be insulated, as the fire brick needs to be exposed to the air for cooling so as to keep it below its melting point.

The color of the surface is also a factor in the heat loss of a furnace. Dark colors, such as black, sometimes radiate



A Car Furnace of the Over-Fired Checkered Arch Type

enough heat to balance the retarding effect of the insulating brick used in the furnace wall. Light colors such as white or light grays radiate very little heat. Light shades of gray are very commonly used for industrial furnaces.

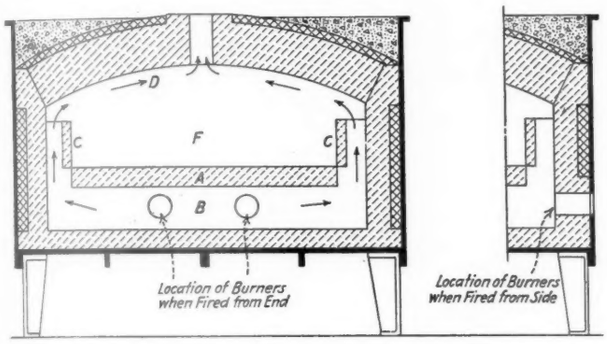
Advantages of Low Pressure Air

Low pressure air which is the atomizing and combustion air in the combustion type burner has several marked advantages over high pressure air. The cost of producing high pressure air is considerably more than that of low pressure air. One horsepower will, under average conditions, produce about five cubic feet of compressed air of 80 lb. A good high pressure burner will induce about 5 cubic feet of free air per cubic feet of compressed air; that is, each horsepower will develop about 30 cubic feet of air available for combustion. One horsepower with a fan type blower will develop about 200 cubic feet at 10 oz. or 6.6 times as much per horsepower. The initial cost of the compressor is many times that of an equivalent low pressure fan blower. The maintenance cost will be exceedingly low with the fan type blower as compared with the compressor. The refractory lining will last much longer with low pressure air as it gives a softer flame with much less velocity; that is, less torch action. The noise of the high pressure burner is a deafening roar as compared with a low hum with the low pressure burner.

The fuel used should be sufficiently fluid to atomize and flow freely. It should be free from dirt and other foreign matter, as this seriously interferes with the proper regulation of the fuel to the burner. The regulation of the fuel at low capacities will be exceedingly difficult unless the oil is clean and properly strained before going through the regulating valve. The clogging of the oil regulating valve throws

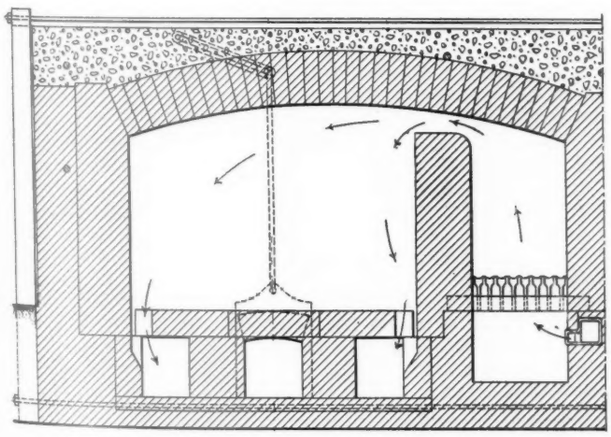
the furnace out of balance, reducing furnace temperature and also changing furnace atmosphere.

The oil pressure should not be too high. The higher pressure requires less opening of the regulating valve, hence small particles will readily clog it. For average fuel oil a pressure of 30 lb. per square inch is sufficient. If the fuel is heavy, the best way to reduce the viscosity is by a steam heater. The oil may also be heated by running steam pipe lines along with the oil line. The oil line may be passed over the furnace vents with fairly good results. This method does not take care of the starting period, but the oil can be conveniently heated for starting by a torch, applying the heat to the oil line and strainer.



An Under-Fired Furnace

It is not good practice to reduce the viscosity of heavy oils by mixing lighter oils, because it is almost impossible to get a thorough mixture. The heavy or thin oil not properly mixed is difficult to control, as a greater amount of thin oil will pass the valve than of the heavier oil. The result will be a pulsating flame, causing the furnace temperature and atmosphere to vary.



Example of the Trench-Fired Furnace

Oil Feed Systems

There are various methods of feeding the fluid to the burners. The following are the most common methods:

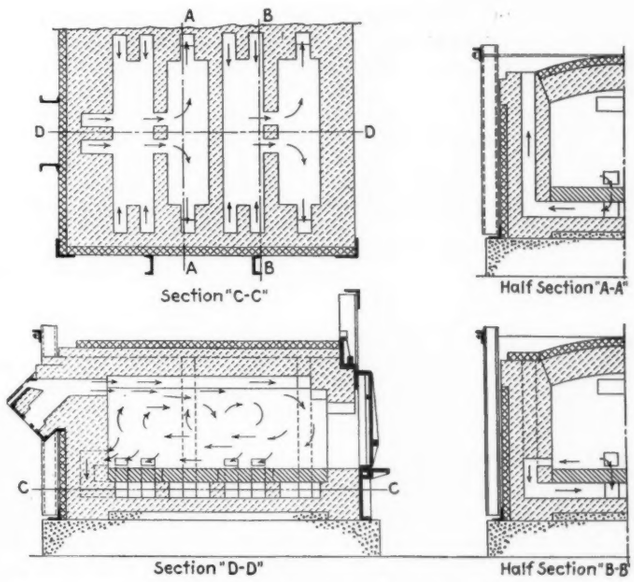
1—Pressure system.
2—Gravity system.
3—Stand pipe system.
4—Circulating system.

The most commonly used system is the pressure or dead end system. Pressure is applied to the tank to force the oil to the various pieces of oil burning equipment. It is usually difficult to handle heavy fuels with this method because the heavy congealed oil in the pipe lines must be forced through the burners in starting at a time when the oil should be at its best. Dirt and sediment have a great tendency to collect in the pipe lines in this system due to the small flow of oil. Pressure on the fuel tank is also a decided fire hazard.

The gravity system is used in many small plants where only a few pieces of oil burning equipment are operated. This system does not work satisfactorily with the heavier fuel oil due to the resistance in the pipe lines. It has about the same disadvantages as the pressure system.

The stand pipe system with an over-flow is very similar to the ordinary gravity system. The fuel is pumped to the stand pipe and maintained at a constant pressure head by an over-flow opening. The fuel is fed to the various furnaces from the lower portion of the stand pipe.

The best system for handling liquid fuels is the circulating system where a rotary or reciprocating oil pump is used to circulate the fuel through a pipe passing all the oil burning equipment and then back to the tank through a relief valve. The relief valve can be set to maintain any desired pressure in the circulating system. Branch lines to each burner are tapped in on the main circulating pipe. Automatic shut-off valves can be installed on each branch line for its protection.



The Over-Fired Open Chamber Furnace

The moment the oil pump is started with this system the congealed oil in the main pipe is returned to the tank. The circulation of the oil has a great tendency to reduce the viscosity of the oil and also to thoroughly mix it. The starting of an oil burner merely reduces the amount of oil returned to the tank. The flow of oil is free from pulsations when the system is equipped with a rotary oil pump. If a reciprocating pump is used, an air chamber should be provided to reduce the pulsation to a minimum.

Savings Effected by Scientifically Designed Equipment

A test was recently conducted in a plant making stay-bolts. The test was for the purpose of determining whether it would be advisable to install modern furnace equipment or to continue with the old equipment. The furnace chosen as representative was a 42-in. by 12-in. by 3-in. under-fired forging furnace. It was equipped with three low pressure inducing type burners. This furnace turned out 5.88 lb. of iron per pound of oil, or 46.7 gallons per ton of metal heated.

The new furnace was a 42-in. by 13½-in. by 2½-in. over-

fired forging furnace equipped with one combustion type burner. This furnace produced 10.05 lb. of iron per pound of oil, or 26.4 gallons per ton of metal heated. The saving in fuel was 43½ per cent. The material heated was free from scale with no traces of pitting. The heavy scaling and pitting of the old furnace had been the source of considerable rejections and other trouble.

An eight-ton car type annealing furnace designed for combustion type burners was recently installed in one of the steel foundries on the Pacific coast. The oil consumption per ton of castings annealed was checked over a period of several months; the average was 13.65 gal. per ton. The average cost of fuel oil during that period was 5.6 cent per gallon which gave an average cost of annealing steel casting of 78 cents per ton.

A neighboring concern had some time before built its own car type annealing furnace and applied high pressure burners. These showed figures as high as 70 gallons per ton of steel castings annealed, or a cost of $4.25 per ton. This company has recently installed a 12-ton electric furnace for the purpose of reducing its annealing cost and increasing the quality of the castings. With this furnace, however, the cost per ton of steel annealed jumped to $7.50 per ton.

A steel foundry in Ohio recently equipped its $20,000 electric car type annealing furnace with two combustion type burners. These effected a saving of $3.50 per ton over the cost of heating the furnace with the electric power. This furnace, although not properly designed for combustion type burners, consumed only 18 gal. of fuel per ton of steel annealed.

Comparative tests were made between the high pressure rivet forge and the low pressure over-fired combustion type rivet forge on one of the large eastern railroads. The total cost of operating each forge, including fuel and air at a capacity of 720 ¾-in. by 3-in. rivets per hour, was checked very closely. The high pressure rivet forge cost 38.44 cents per hour to operate. The over-fired, combustion type rivet forges operated at a cost of 21.16 cents per hour, or a saving of 46 per cent. There were also other savings, such as less burnt rivets, cleaner rivets, less rejections, softer rivets and less heat radiated from the forge, making the working conditions more favorable.

Maximum production per man, per furnace, per unit of fuel with uniform high quality can only be obtained with a scientifically designed furnace, heated with a correctly designed combustion type burner.

"A Level Head and a Feeling Heart"

These Are Requisites of a Successful Leader; Impersonal Relationship Must Be Replaced

By A. Montangie

Civil Engineer (Mechanical Department), Belgian State Railways, Ghent, Belgium

SUCCESSFUL shop management is a technical, social and psychological problem. We shall limit ourselves in this discussion to the latter part in which the relation of men and management are considered—what they should be and how to realize them. The efficiency of a gang, shop, factory or other industrial community depends upon the co-operation of its elements: Man, foreman, manager or leader.

The Man

The mind of a man, taken as a unit of a group or as an individual, is not the same. This psychological truism, well known by political and trade union leaders, is often ignored by the real leaders of men of our industrial communities—the managers. As an individual, the average man is open to reason, and apt to grasp the facts of a case; intelligence leads him; as a unit of a group he is more often open only to feelings receptive to speech—to words, however false, cleverly and enthusiastically repeated—but is entirely closed to reason. He is governed by his feelings. Hence to promote his efficiency, foster the first feeling, guide the second.

The man should have the consciousness of his responsibility, feel that as an individual he is a useful and necessary unit, that his work is worth doing, useful to him first, but to others as well. The pride of trade will follow; also the desire of knowledge of his trade.

The character of the industrial worker—the one engaged in railroading in particular—should be built up of the above named requisites: Feeling of responsibility, pride, knowledge.

How is this usually promoted? Through a system of apprenticeship, steady employment, educational facilities for all hands and all ages. But these consider only the social side of the question; the psychological side is ignored or neglected. The former fosters ambition, but not confidence and personal pride. So long the man is not aware that instead of being a mere money-making machine, he is a necessary, useful unit in which his equals and superiors are interested, and whose interests coincide with his own, the psychological side of the question may be considered as ignored.

Loyalty, enthusiasm and confidence are necessary factors to the efficient operation of any gang. How to acquire these valuable assets is demonstrated by what follows.

Foreman

The link between the men and the management is the foreman. Coming usually from the ranks the foreman possesses the qualities and mind of the man. He should have something more—the qualities, at least part of them, of the manager or leader.

Master of his craft he must be; his subordinates must rely upon him and obey his orders, but above all, he must be a leader, know individually the men of his gang, be ever present among them. His authority is based on the knowledge of his men, character and professional ability. To grasp the mind of an individual is not an easy task. How to issue an order, supervise its execution, correct a mistake, will vary with each unit. The intelligent, active fellow will not want many explanations as to how a job is done, but will want to know why it's done. The less intelligent, lax worker wants the reverse.

What about the much asked question "How many men should a foreman supervise?" Precise figures cannot be given; too many factors vary—the job, size and facilities of

*Submitted in the Shop Management Competition, which closed September 23, 1923.

shops, dispersion of men, quality of the men. Compare a boiler repair shop with a car repair shop, or a track gang. In the first case, 12 to 20 is about what the foreman can manage. Twenty-five to 30 is a good average for the second, as much as 50 for the third. The real number is to be gaged by the value of the foreman.

The foreman's pride of enjoying the confidence of his men through continual intercourse must be supplemented by the pride of enjoying the confidence of his manager. A dissatisfied foreman usually results in an indifferent crew. A manager should not only issue orders, he should explain them, show his foremen the "why" of things, their use in the economy of the shop; lead him, advise him in reading matters pertaining to his trade, foster the creation of clubs, let him come in contact with other roads and get acquainted with other trades.

Specialization is nowadays a necessity, which is apt to make one too one-sided. A leader should broaden his foreman's mind. The watertight bulkheads between the different departments should be removed, which brings us to the point—What should the manager be?

Manager

Usually a manager (head of a department) of any branch of a railroad is a very busy fellow; much of his time is taken up by clerical duties and office work, and the very little, if any, that is left is available for a hurried trip to part of the works he has the control of. This intercourse with his foremen is limited to a few minutes devoted to acquaint them with his orders—with his men: nil, and often all orders are issued on paper.

It may seem a big proposition for a manager to know personally a dozen or more foremen and several hundred men of various callings. Is it possible? At first sight, no. But let us look into the question further.

What is necessary is not so much that the manager should know each of his subordinates by his christian name, but that each of his men should know him, not as an entity hidden in a far-away office, but as a member—the first—of their community.

A manager, be he a college man or not, is often a man with a broader and more refined education, and although a man is a man, his superior intelligence gives him a higher standing. His presence among his subordinates will secure him their confidence, and prove to the men that he is interested in their work and welfare. A good word, a simple question, a little advice will do a lot more towards good understanding than a set of meetings, speeches and recommendations.

A couple of hours a day away from the office and devoted to the shops will do wonders. A foreman does not like to travel to a far-away office for an inquiry, but give him the opportunity of interviewing you at the place of his work. Instead of perusing lengthy reports indifferently made up, ask him what you want to know. You will get your information better and quicker. Acquaint the foreman with your views, your reasons for ordering this and that, the goal you have in view, etc. A stop of a few minutes between your machine tools will wonderfully accelerate the r.p.m. of many a machine tool when the operator feels you are interested in him. Many an improvement has been suggested in this way. Spend a day off driving one of your engines. Explain to the driver why to spare coal and oil, why to keep the engine clean, and discuss any other topic in which he is interested. Examine the records a few months later, and the results are often astonishing. You may consider it los time. It is not; dollars and cents may promote steady and good work but not enthusiasm that makes a man proud of his trade, of his shop and of his "boss." Lead a shop or a gang with a level head, but also with a feeling heart. The men will respond better to the second than to the first.

The problem of efficiency—the human factor alone considered—is to be solved by the intercourse and mutual understanding of leader and men. Put yourself as manager in the man's stead. You can't put much faith in and support enthusiastically such nebulous deities as an "administration," "board," "railroad," etc., of which you know no more about than of the old gods of antiquity or the "Great Loma"; but you will feel proud to be appreciated and connected with the "big man" and give him your unreserved support.

A secondary result will be that your hold over your men will counterbalance the influence of outsiders, trade union leaders and politicians, and will strengthen the authority of the rightful leaders of men—your foremen. Of course, the same applies to higher spheres. The basic principle is: Replace the actual impersonal relation between elements by personal knowledge of each other.

This principle applied in the various branches of the mechanical department of a railroad has, in my own experience, worked well. The principle is not new, it is in fact very old, and properly applied—the case of the apprentices on the Santa Fe is an instance—the principle will work well in industry, just as in old times when machinery was scarce and the human factor the only factor.

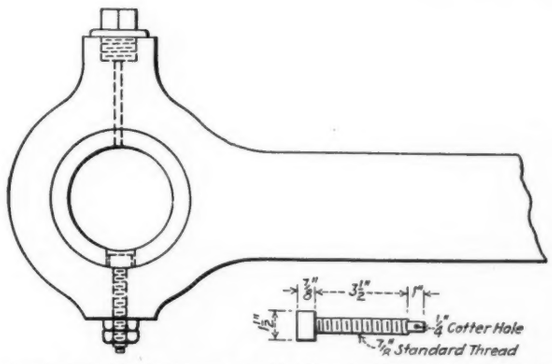
Rod Bushing Dowel

By H. L. Loucks

General Foreman, Erie Railroad, Dunmore, Pa.

AN excellent device for holding rod bushings in place is shown in the drawing. It has been tried out on the Erie and proven to be satisfactory under all conditions. The method of applying this device is as follows:

The rod is drilled and tapped to 7/8 in. standard thread, then after the rod bushing is applied, a 7/8-in. hole is drilled through the bushing. Then a small boring bar with a 1 9/16-in. cutter is placed through the hole drilled in rod



Method of Applying Dowel for Holding Bushing in the Side Rod

and the spindle of the machine is fed upward until the cutter strikes the steel part of the rod.

The rod dowel is then screwed in from the inside and two faced nuts and a cotter applied. This arrangement prevents the dowel from working loose as well as turning of the bushing in the rod. It is practically impossible for the bushing to get loose. When it is desired to remove the bushing for renewal, it is only necessary to remove the dowel and then take out the bushing in the usual manner. In case shims are to be applied, the bushing is given a one-quarter turn in the rod, and then drilled and counterbored as before.

Examples can be given where a set of rod dowels have lasted five or six years and on account of their long wearing qualities, it has not been found necessary to keep a large stock of dowels on hand.

Welding Standardization in Locomotive Shops

A Review of the Various Methods Used on Boilers, Fireboxes and Running Gear

By James S. Heaton
Welding Supervisor, Wabash, Decatur, Ill.

THE development of welding in locomotive repairs has been exceedingly rapid during the last few years. A few large railroads have employed experts to supervise the work, who report directly to the superintendent of motive power. It is the expert's business to make the practice of welding uniform in all the shops of the system so that the failure of one shop to get results can be traced to its origin. The supervisor of welding must find a successful method of performing each operation and require each shop to work according to his instructions. The standardization of welding is simple under such direction. It is more difficult to standardize on roads that do not employ a supervisor, but the necessity is even greater.

Keeping of Proper Records

Records should be kept of each particular welding job on a locomotive and should be filed for future reference. For example, on boiler work a form, shown in Fig. 1, showing the side, crown, door, flues and wrapper sheets should be used to show the repairs made and seams that were welded, together with the date, name of the operator and name of the shop. A form showing the different frames, Fig. 2, should also be used to show the weld and the method used in welding. Similar reports should be made of welded tires and cylinders as shown in Figs. 3, 4 and 5. Three copies of these reports are filled out, one to be forwarded to the superintendent of motive power, one to the supervisor of welding and one to be kept by the shop doing the work. For back shop work a form similar to the locomotive report should be used to show all the parts welded while the engine was in the shop. A careful check should be made at different times to ascertain the wear and condition of the welds and if any job does not come up to expectations, a satisfactory method should be found.

Standardization of Equipment

The supervisor of welding should be held responsible for the output and upkeep of all welding equipment. He should be allowed to select the equipment that he deems necessary to give the required output. All equipment, as well as the method of welding, should be standardized. This is necessary for two reasons: First, that repair parts be on hand at all times; second, that after teaching an operator one machine, he can work on any of them without further instruction. Some machines will give a greater output than others, while some will produce better work than others.

The supervisor of welding must be familiar with all makes of machines and competent to select the best suitable for the work. There are so many different kinds of wire, brass rods, cast iron rods, fluxes and other necessary supplies on the market today that it requires some one familiar with welding work to be able to select the best materials. The best obtainable is the cheapest and the supervisor should be on the lookout at all times for better materials.

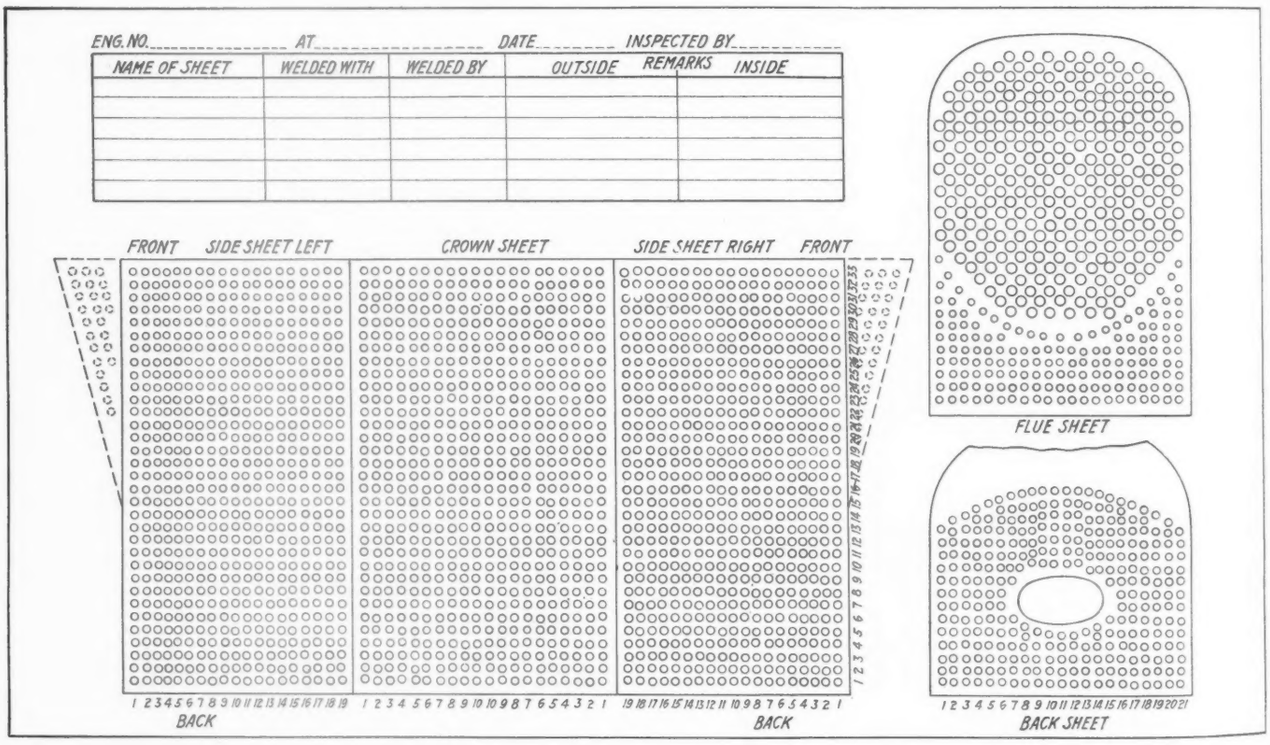


Fig. 1—Form for Reporting Boiler Work

As the repairs to welding equipment are of a delicate and exact nature, it requires an expert workman to perform such work. There should be a centralized repair shop to take care of the entire system. All torches and regulators should be forwarded to this shop for repairs when necessary. It has proved to be more economical to have enough equipment on hand to allow an extra set to be at the shop at all times, than to require the use of a faulty outfit, which is not only dangerous to the operator, but to others around him.

Layout of a Welding Shop

A welding shop should be laid out so that work may come in at one end and go out at the other. An enclosure of curtains, or a wall to keep the sand from flying over the machinery, should be erected for cleaning all material before it reaches the welder. A sand blast is best suited for this work. An enclosure should also be erected for chipping to prevent chips from flying. A preheating furnace served with

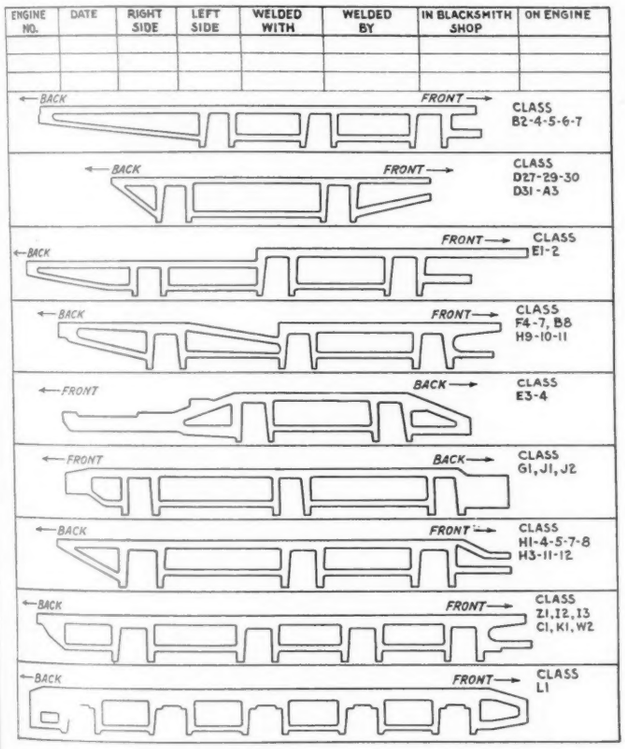


Fig. 2—Form Used for Reporting Welding Work on Frames

a swinging air hoist and provided with a cast-iron slab high enough for a welder to work at comfortably should be placed adjoining the enclosure and next should be an open forge so constructed that it will accommodate three separate fires. A swinging air hoist that will handle all the heavy work from the cleaning rooms to the welder and on through the shop is an excellent aid in expediting the work. More work can be turned out if the proper facilities are installed to help the welder instead of ruining his temper and perhaps cause injury to him by lifting hot and heavy castings.

A stationary machine should be installed at any point in the shop, such as the valve, rod, tank, or driving box area, where there is sufficient work to keep a welder busy. This will eliminate the transporting of material to and from the welding shop and also save the time consumed in waiting for a traveling crane.

The Traveling Work Shop

One of the most useful equipments that a railroad can operate is a traveling work shop. This shop is equipped with a gasoline-driven electric welding machine, a gasoline-driven air compressor, an acetylene welding and cutting outfit, a small lathe, drill press and emery wheel. Tools capable of taking care of stationary boiler work can also be included. This work shop, operating over the entire system, can make repairs to stationary boilers at pumping stations and depots and to switches, frogs, bridges, pipe lines, etc., eliminating the cost of tearing down and replacing material that can be repaired cheaply where it is installed.

Proper Welding Instruction

In making preparations for a weld, the following must be given consideration: Condition of surfaces, bevel of material, position of material, provision for expansion and contraction, use of proper filler material and allowance of sufficient room for the welder to work.

Failure to observe any of the above considerations will tend to make a bad weld. All surfaces must be free and clean from foreign substance, such as dirt, scale and grease. Welding on a dirty surface will make a seamy and faulty weld. All boiler sheets, patches, frames and other material that is broken must be beveled to 45 deg. on each edge, leaving an opening at the underside of 1/8 in. to be sure that the weld will be made through the entire piece. The proper filler rods to be used for each operation should be noted in the instructions. It is important that the welder be allowed enough room to work. His work is tedious and if placed in such a position that he is under strain, the result is apt to be faulty. All of these precautions should be taken to assist in caring for expansion and contraction. Sheets and patches that are applied on a straight line must be corrugated along the line of welding. Smaller patches should be cut either in diamond or oblong shapes.

Each foreman and welder who follows instructions will find his work more satisfactory and more easily understood. As his experience widens, he will doubtless submit suggestions for improvements and better methods. These should be carefully considered and if a better way is suggested, it can be adopted in place of any practice then in force. However, changes should be submitted to the supervisor of welding, who should always issue the instructions authorizing any change.

Welding of cast iron, brass, cast steel, forgings and all heavy work that is done by the acetylene process must be preheated before welding. This is done to save gas and the welding will begin almost immediately after the torch is applied. As the acetylene operation is very costly, it can readily be seen that the heating of the heavy parts will eliminate a great deal of this cost. The preheating of cast iron, brass and other heavy castings is not only necessary for the saving of gas and time, but is also necessary in many cases to take proper care of expansion and contraction.

Acetylene is dangerous if not handled carefully and extra precautions should be taken to eliminate personal injury and also possible damage to railroad property. All equipment that is in need of repairs should be taken at once to the tool room. Operators should have all parts of the body covered and well protected. They should not attempt to weld without using the proper glass to shield the eyes. All welding operations should be screened from other workmen. Insulation of all wires should be kept dry and in good condition.

Instructions for Welding Boilers

For purposes of standardization, the following rules have been drawn up to cover work on boilers:

1. Welding will not be permitted on any part of a boiler that is wholly or in part in tension.

2. Staybolts or crown stays must not be built up or welded to the sheets.

3. Holes which are larger than 1½ in. in diameter, when

entirely closed by welding, must be properly stayed.

4. Only competent operators will be allowed to weld on boilers.

5. All parts must be clean before starting and must be kept so during the welding.

6. When repairing fireboxes a number of small patches should be avoided and full sheets applied.

7. Never cut through an old weld to apply a new patch.

If a cutting torch has been used to bevel a sheet, a chipping hammer should be used to remove all the burnt metal caused by the torch. The back-step method should be used in all boiler welding. This insures better expansion of the sheets than the old method of continuous welding. On calking edges and seams the welding should extend on the under sheet the same thickness as on the top sheet. By this method the seam will present a sloping edge to the heat, thereby eliminating fire cracks in the top plate at the rivets.

When welding jacket studs on a boiler head, the stud should be beveled on one end and the place to be welded on the boiler cleaned off. Then hold the stud in one hand and tack it to the boiler and weld completely around it. This eliminates drilling out the broken stud and tapping and renewing for a new stud. Care must be taken not to weld over the old stud as it is liable to leak. This method can be used for welding studs for oil pipes on the boiler, as well as sand pipe clamps and studs to the frames.

Welding Work on Fireboxes

When it is desired to weld a firebox without removing the back end, the welding edge should be prepared the same as on boiler sheets. Then bolt the sheet securely in place, taking care that there is a uniform opening of 1/8 in. all around the welding edge. Drill 1/2-in. holes, spaced about 14 in. apart, and use two pieces of 1/2-in. by 2-in. by 4-in. boiler plate on both sides of the sheet. Clamp with 1/2-in. machine bolts, being sure that all bolts are drawn tight. Rivet the top of the flue sheet to a point not less than 12 in. below the center of the crown, then start welding by using the back-step method, moving the clamps when necessary. Next weld the entire door sheet. All welding on riveted lap seams in a firebox should be applied to cover the entire edge of the sheet and should extend on the under sheet a width equal to the thickness of the top sheet.

In welding around the door, cut outside of the first row of staybolts and trim the outside edge of the sheet just inside of the rivet holes. Bevel all edges 45 deg. and fasten the patch in place, using the same method as for side sheets. Remove the row of staybolts adjacent to the patch and use a sand-blast to clean the edges. Weld by the back-step method.

In renewing the upper part of the door sheet, cut out a patch allowing enough metal so that the line of the weld will come below the second or third row of staybolts. This will take care of contraction. Have all edges beveled to 45 deg. and use a sand-blast to clean the edges. Butt weld to the crown and side sheets. The sheets should be held in position by the same method as used for the side sheets. Weld by the back-step method.

In welding the side sheets, cut the sheet 12 in. below the crown sheet. Remove all staybolts and rivets and also the adjacent row of staybolts in the upper sheet. Cut the door and flue sheet inside of the rivet holes and bevel each to 45 deg. Place the sheet in position, using bolts in the mud-ring 1/16 in. smaller than the holes, and bolts in the top of the sheet with staybolts screwed in from the outside to force the sheet against the bolts to hold the sheet in position. Sand blast the edges and weld the sheet at the top first, using the back-step method, then weld the door and flue sheet. Remove all bolts and rivets before the weld cools.

Where possible, all side sheet patches should be cut either in diamond or oblong shape. Never allow more than 8 in. in the vertical seam. When applying such patches, allow sufficient bolts to hold the sheet in position with staybolts screwed in from the outside to force against the bolts. Remove the adjacent row of staybolts in the sheet. Clean the edges by a sand blast and weld by the back-step method, using a mild steel electrode. Remove the bolts and staybolts before the weld cools.

For all leaky seams that are beyond calking, remove the rivets and cut the outer sheet on a line with the center of the holes. Bevel the sheet to 45 deg., sand blast the edges and lap weld, filling the holes in the under sheet. This eliminates the renewing of a sheet that has worn edges.

If a wrapper sheet is wheel worn 40 per cent. or less, the worn place can be replaced by welding. Remove all staybolts in the section to be welded and clean off by using the sand blast. Then weld to the original thickness. Care should be taken to weld around all staybolt holes so they can be tapped out to full thread.

Flue Sheets

For the front flue sheet, the welder should use a cutting torch and cut the sheet at the knuckle. If the top of the sheet is in good condition, cut just above the top row of flue holes. If it is not in good condition, then cut out the entire sheet and bevel the edges to 45 deg. Place in position by using a strong back and tack weld around the sheet at points about 12 in. apart. Sand blast the edges and weld by the back-step method, using a mild steel electrode as in previous operations.

In welding broken flue sheet bridges, it is best to cut the crack to 90 deg. and have a 1/8-in. opening at the bottom. Clean off with a sand blast and drive an expander in the flue hole. Drive the expander out before the weld cools.

For a three-quarter sheet cut between the top of the staybolts and throat sheet braces and remove the top row of staybolts. If the crown and side sheets are in good condition, the flue sheet may be riveted. If not, then cut off behind the rivet holes and prepare the same as for welding a door sheet. Weld by the back-step method.

For a whole sheet, if it is in good condition at the mud-ring, cut between the bottom row of staybolts and the mud-ring. This saves time and the expense of removing the mud-ring rivets. Weld in the same manner as for a three-quarter sheet.

For a crack in the back flue sheet knuckle, bevel out the crack to 90 deg. from the water side, if possible. Sand blast the edges and weld by the back-step method, using a mild steel electrode. The weld should be reinforced 1/8 in. on the fire side.

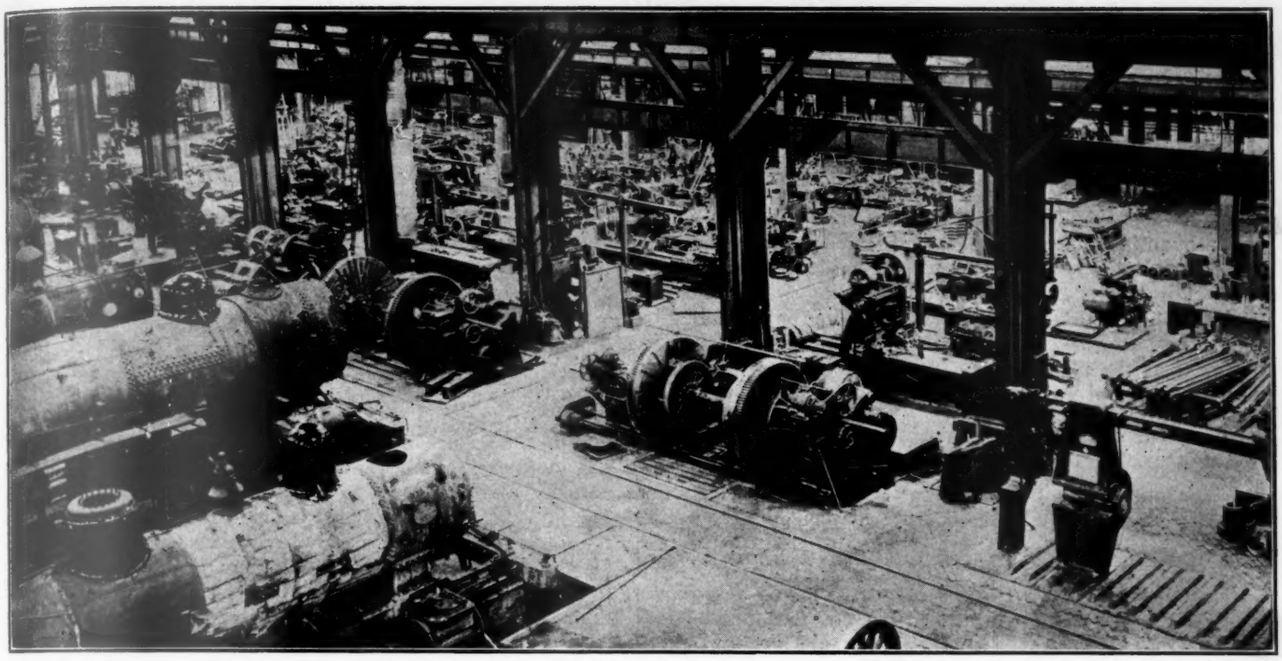
In welding flues, have the sheet and flue beads cleaned off completely with the sand blast, begin welding at the bottom center of the flue and finish at the top center. Never weld down on the side of a flue. Start welding at the top of the flue sheet and then finish each succeeding row before starting on the next. This will keep the heat down.

Repairing Mud-Rings

For a mud-ring patch cut out all defective parts and remove the first row of staybolts adjacent to the cut. Bevel the edges of the sheet and patch and place the patch in position, using bolts 1/16 in. smaller than the rivet holes in the mud-ring. Use the sand blast to clean and weld by the back-step method.

To prepare for the welding of a broken mud-ring remove enough from the bottom of the fire box plates to permit free movement of the welding tools. Vee out the mud ring to 45 deg. on the top side of the crack, leaving a 1/8-in. opening at the bottom and force open the fracture by driving in a small wedge. This will take care of expansion. Clean off with a sand blast and weld.

(*To be concluded next month.*)



A Few Points for Erecting Shop Men*

Practical Suggestions Leading to Smooth Operation, Greater Efficiency and Improved Working Conditions

By William Hall
Erecting Foreman, Chicago & North Western, Winona, Minn.

SOME of the larger shops have separate stalls for stripping the engines. This is desirable in either a large or small shop for then the erecting pits and surroundings can be kept cleaner, no lost motion or loss of time is experienced while waiting for the wheeling or unwheeling of the engines and the removal of the parts stripped, and it makes for efficiency. In shops where separate stalls are not used for stripping, no engine should be permitted to enter the shop without first having the pits cleared of all dirt and debris from the engine last occupying it, thus giving the men assigned to that pit a clean place to work in and around instead of one littered up with all kinds of junk—nothing is so conducive to any man's happiness and efficiency as cleanliness.

Ash pans and fireboxes should be thoroughly cleaned before the engine enters the shop. Such work should always be done over the cinder pit before crossing the turntable as this saves time and the shop drainage is not blocked up. Time and again I have seen an engine placed over the erecting pit with the ash pan filled with cinders and a great bunch of unburned coal in the firebox which is dumped into the pit, thrown out again, loaded into wheelbarrows and carted away to the ash pile. Again I have seen engines hauled dead from outlying points in this condition, whereas all this should have been left at the starting point.

A good routing schedule is a wonderful help to the erecting foreman, providing it is efficient and lived up to in every department, for then he can figure accordingly. Foremen's meetings may help some but the better way, in my estimation, is to get each foreman into the office separately and go over his part of the various operations. You can then get his own true opinion of what is delaying him if delays occur.

Importance of Special Gangs

Specializing the work is an excellent assistance for the erecting foreman. For instance, special men for hanging guides, preparing and laying out shoes and wedges, special men on steam chests and rocker boxes, and so on all through it works out to advantage for obvious reasons.

I first conceived the idea of specializing the work of the erecting department when I was an erecting foreman in one of the largest locomotive repair shops in Chicago. It was started in a small way first, then finally the whole shop was specialized. I worked the men into it gradually, being careful not to give out the idea of what my purpose was, but it worked out well and met with the approval of the men.

There is very little work in the erecting department that can not be specialized. I had men whose work it was to fit pedestal binders, file jaws and lay out shoes and wedges. When done with the first engine out, they would move to the second engine out, as the list showed. Another gang would hang the guides, ream the bolt holes, put in the pistons and cylinder heads; another would be assigned all cab work; another reverse gear and throttle lever and quadrants; the next, eccentrics, straps and blades and hanging links; another gang would take the brake rigging, and so on throughout the whole locomotive. The number of men in each gang and the number of gangs would depend largely upon the size of the shop. That would be easy to determine.

There is no difficulty whatever in training and developing

*A paper submitted in the Erecting Shop Competition.

the men for the various classes of work. Care should be taken, however, in the selection of the men to start with as some may be more adapted for one particular work than another. That more can be accomplished by this method goes without saying as each gang would have the necessary tools and would see to it that its special work was made as easy for themselves as possible. Take the guide gang for instance. In order to help themselves, they would have bolts in the rough in stock, guide liners of various sizes would be gotten out in quantities instead of just as required when the work is distributed indiscriminately.

In many shops the work of the erecting foreman is retarded by the boilermakers. In my opinion only small jobs should be performed by the boilermaker in the erecting department as the machinists in that department cannot work to advantage and are delayed considerably when the boilermakers are around. It is not only an inefficient way of working, but is not conducive to safety first. It is claimed that time is saved by doing some big jobs on the erecting floor without taking the boiler to the boiler shop, but my 40 years' experience tells me a different story.

Value of a Clean and Orderly Shop

The bunching up of engines on one pit is a deplorable condition and retards efficient working of the erecting department. I have seen as many as four heavy engines stripped on one pit—I do not here refer to the stripping pit. Anyone can imagine what a jumbled up mess it is when parts of several engines are left around, as is often the case. The condition is exaggerated when the engine is stripped for the boiler shop. Such a situation, however, can be avoided if before stripping the second or third engine the parts of the first are loaded and set away till wanted. The loss of time in sorting out the parts required would not only be in the interest of economy of time and material, but in line with safety, as men would not be tumbling over parts and injuring themselves. Again, in my opinion, engines should be washed off thoroughly outside and underneath before entering the shop. The shop would then be kept much cleaner and a lot of obscene language would be avoided.

All pits in the erecting shop should be kept as clean as possible, well drained and of suitable length and depth so that they may be convenient for the men to work in.

Other Factors Tending Toward Efficiency

In the larger shops particular attention is given to crane service. In the majority of shops, however, ample crane service is conspicuous by its absence, although it is just as essential in the smaller shop as in the larger. It is a great time saver to have ample crane service. This service can be abused, of course, but this may be checked by good supervision.

As soon as an engine is stripped and the parts cleaned, the foreman should see that the various parts are distributed to the different departments as soon as possible and should follow them up as closely as is consistent so that no delay occurs. In the event that he thinks certain parts are going to be late in getting out, he should report at once to the general foreman so that he may take care of it, as often times he has pushed something ahead of them. Particular attention should be paid to the running gear, such as wheels, driving boxes, etc., to see that they are being pushed by the machine shop for after an engine is wheeled the rest of the work goes along nicely if well managed.

The distribution of the classes of engines on the erecting floor is an important factor when output is considered. Care should be taken not to have too many of one class, or too many in for general overhauling or heavy repairs at the same time. The shopping of engines should be well balanced; that is, so many general, so many heavy and a certain number for light repairs.

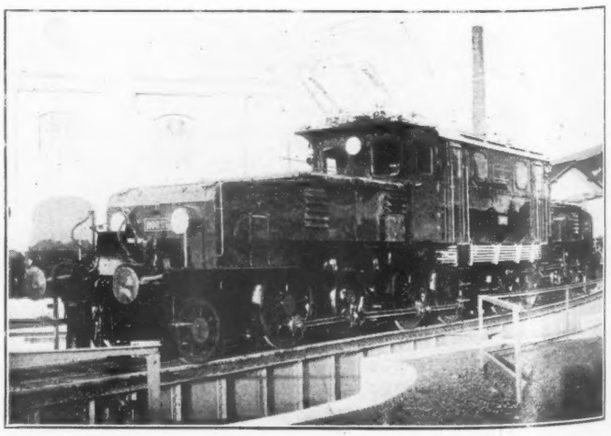
Another important factor is having the employees in each department well balanced. If the erecting department is undermanned, the other departments will flood it with finished work, or, on the other hand if there are too many on the erecting side, more or less time is wasted waiting for this or that and this does not make for efficiency.

Another factor tending towards efficiency of the erecting floor is keeping close watch over parts so broken or worn that they need replacing. Requisitions for such material should be made on the storehouse at the earliest possible moment and if in stock should be drawn out and gotten to the machine shop and the foreman of that department advised of what is required. If parts are not in stock, the general foreman should be notified so that he may follow up the requisition and bring pressure to bear where it will be the most effective.

Special attention will be paid by an efficient erecting foreman to the frames of the locomotive. He should be sure that the jaws are squared and the binders a good fit and well bolted. Shoes and wedges should bear well on the face of the jaw and not on the fillets, which might thereby cause the flange to break off. Driving boxes should be well fitted between the shoe and wedge for there you have the foundation of your engine. If these parts are well maintained the time between shoppings will be materially prolonged.

One great trouble is that some of the men higher up have the word "output" so obscuring their vision that sufficient time is not given to the man in charge of the erecting department to do a first-class job. Their slogan seems to be "get it together in as short a time as possible, regardless of the quality of the job." If more attention was paid to the quality of the work done the time between shoppings would be reduced materially and the locomotive would be in service and earning dividends during a larger percentage of the time. I do not want to be understood as advocating taking more time than is absolutely necessary, but if a job is worth doing at all it is worth doing right. This will enable the locomotive to give better service, require less attention in the roundhouse and therefore be a more economical unit.

There are a number of other ways in which an erecting foreman may increase the efficiency of his department: By having his men well organized, by quick distribution of his work to the other departments and following it up in due time, and by keeping a good supply of small materials on hand so that if a stud or nut is required he can furnish it without loss of time. Last, but not least, by keeping his men well satisfied, working with them instead of the men working for him, and by both working in the common interest of the railroad employing them.



Gilliams Service

One of the New Locomotives for Austria's Electrification

The Fatigue Element in Accident Prevention*

Accidents Apparently Vary in Direct Proportion to Fatigue—Human Machine Requires Scientific Attention

By William Baum

President, William Baum & Co., Consulting Engineers, Milwaukee, Wis.

IN our day of highly developed industries, the success of a manufacturing enterprise depends greatly upon the care given to machinery and materials. Nothing can be left to chance. Types of machines are selected to suit existing conditions and to operate at the proper speed with a minimum of friction. Steps are taken to prevent overloading and overheating. The greatest output is maintained consistent with long life and low depreciation.

However, the mastery of these technical and economic phases of manufacturing is insufficient in a modern plant.

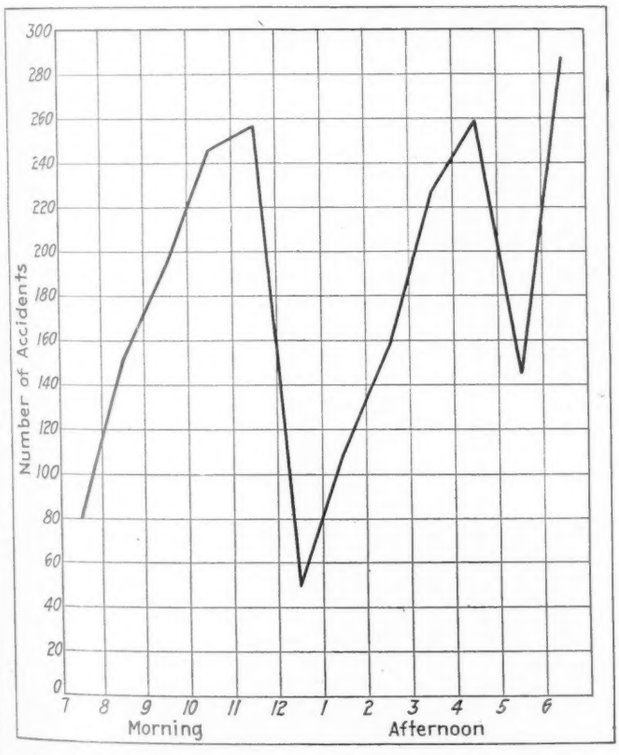


Fig. 1—Relation of Fatigue to Accidents—As to Time of Day

During the last few years, industrial executives have come to the realization that there is another problem which equals or even surpasses in importance that of mechanical devices and materials—the problem of the human machine. A. P. Fleming, one of the ablest electrical engineers in England, summarized his opinion in these words: "I have no hesitation in suggesting that the most important of all the problems with which we have to deal, and one which will be of increasing importance in the future, concerns the human element in industry."

The safety movement deals primarily with the human machine. Its leaders have long recognized the fact that the prevention of accidents increases output, reduces manufacturing costs and is of great benefit to the workers. This movement, based on economic and humanitarian motives, commands our full support and co-operation. It is not generally appreciated that fatigue causes accidents and that the fear of accidents causes fatigue.

What is fatigue? What are its causes and effects?

What is Fatigue?

All work, either physical or mental, produces in the body poisonous substances causing fatigue. The degree of fatigue depends, of course, upon the condition of the worker. The same amount of effort will produce greater weariness in a weak person than in a strong person; in a person poorly nourished than in one well nourished; and in boys and girls more than in grown-up men. Many people who are always tired suffer from intestinal poisoning, the results of indigestion being similar to those of excessive work. We have an analogy in the automobile engine which becomes fatigued when there is an excess of carbon in the cylinders. This carbon must be gotten rid of before the car can operate satisfactorily. In the human machine, the indigestible portions of food are waste matter, just as carbon is the incombustible

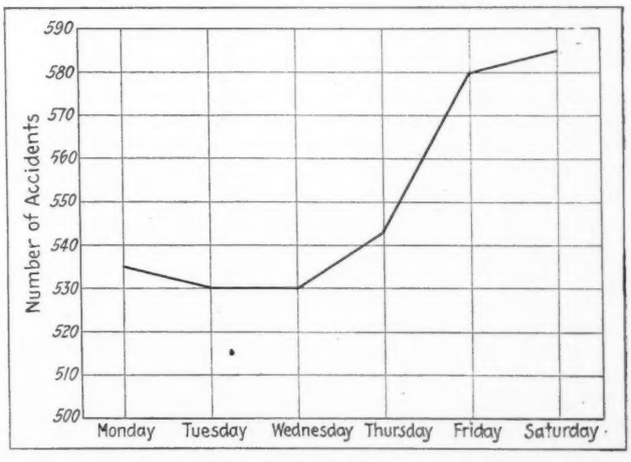


Fig. 2—Relation of Fatigue to Accidents—As to Day of Week

portion of gasoline in the automobile engine. Both must be eliminated.

There is a distinct connection between fatigue and accidents. In the hours when fatigue of the worker is still slight, there are scarcely any accidents, while in the sections of the working day when fatigue has grown to an appreciable extent, the number of accidents increases. This is clearly illustrated in Fig. 1, which shows the relation of accidents to the hours of the working day. Between 11:00 and 12:00 o'clock in the morning, and between 4:00 and 5:00 o'clock

* An address delivered at the Foremen's Safety School, Milwaukee, Wis., January 15, 1924. This school is conducted by the Milwaukee Association of Commerce Safety Division, which is affiliated with the National Safety Council. The sessions are held once a month during December, January, February, March and April. Sectional meetings are held from 7:45 to 8:30 p. m.; These include the following sections: Machine shop, sheet metal, textile, woodworking, building construction, foundry, electrical, packers and tanners, and an All-Trades Section to cover trades not included in the other sections. After a brief recess following the sectional meetings, general sessions are held from 8:45 to 9:30. The school is open to foremen, assistant foremen, superintendents, managers, safety supervisors and members of safety committees. In general, important phases of industrial betterment are covered, including accident prevention, production, labor turnover, fire prevention and leadership.

in the afternoon, when fatigue has grown, the largest number of accidents occur.

The relation of accidents to the days of the week, shown in Fig. 2, is of considerable interest. On Monday, the number of accidents is slightly larger than on Tuesday and Wednesday, a fact well known to industrial managers. Toward the end of the week, the accident curve rises sharply, reaching its maximum on Saturday (full day). That an increase of fatigue endangers safety, could be shown by numerous statistical data collected by governments and insurance companies.

Minimizing Fatigue

The difficult problem arises as to how to eliminate or at least minimize fatigue. The conclusions which can be derived from the curves suggest the introduction of rest periods and a shortening of the working day. In Europe, short rest pauses in the morning and afternoon are quite common, and it is claimed that the results are more satisfactory, particularly from the standpoint of output. It is impossible to specify the correct number of working hours per day to fit all cases. The best results will be obtained by a careful adjustment of the working hours to the conditions of the operation concerned.

General improvements in the working conditions contribute greatly to the elimination of fatigue. Dazzling lights improperly arranged, which strain and irritate the worker's eyes, should be avoided. Ventilation may often be improved; dry air can be washed and moistened. Noise, a great cause of fatigue, should be reduced as far as possible. Chairs for work and rest may be designed to be more comfortable. Workers should have sufficient time to eat their lunch without hurry, so that digestion is facilitated. The management has many other opportunities to do its share toward the elimination of fatigue, the reduction of accidents and the increase of efficiency in the plant. A scientific analysis of all factory operations will greatly contribute to the elimination of fatigue. It has been shown that a motion study usually reveals useless, ill-directed and inefficient movements of the workers. As soon as these false movements are discarded, the worker can perform the operation with the least effort and the largest resulting wages.

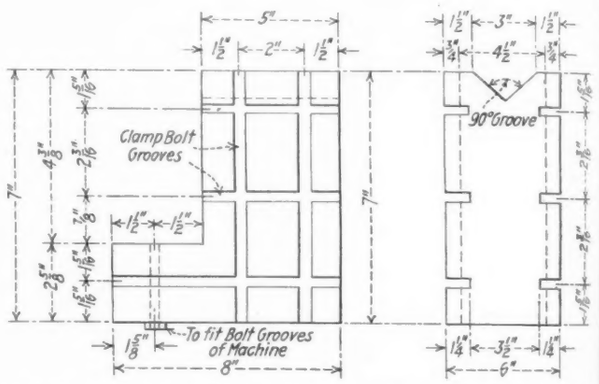
Relation of Fatigue to State of Mind

There is no question that the worker's state of mind bears an important relation to fatigue. If wages are too low or unequalized, the workers become dissatisfied, output suffers and fatigue increases. The importance of well equalized production standards and wage rates cannot be overstated. The only available methods to bring about equalized conditions is through "time study," a procedure which times the elements of the operations, adding suitable allowances for fatigue and personal requirements. A further improvement may be made by introducing a wage incentive plan which is based on these time studies and which establishes the identity of interests between employer and employees. There are many concerns today which operate so-called gain-sharing plans with the result that production per operator and earnings per hour increase, manufacturing costs and labor turnover decrease and accidents are rare. Such results are possible only if working conditions are as good as they can be made.

The problem of handling labor on a scientific basis is still regarded by many as academic and impractical. There are as yet many conservative employers who prefer to rely upon their past experiences in dealing with the problems of labor. But the day is approaching when executives will take advantage of the experiences of those who have taken the time to analyze the human machine with the same care and scientific attitude that is applied to the mechanical machine. Questions of safety, output, costs and efficiency cannot be divorced from the human element. Industrial peace and prosperity can be made a reality through concerted efforts based upon scientific principles and dictated by high-minded motives.

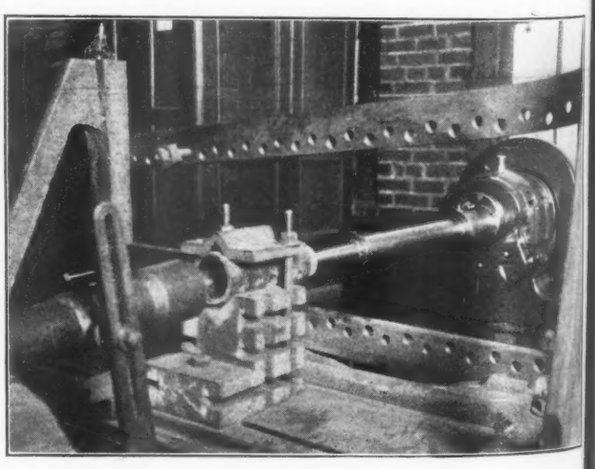
A Jig for the Heald Grinding Machine

A HEALD internal grinding machine can be readily utilized for grinding air pump main valve bushings and small work of a similar nature by the use of the jig shown in the sketch. The jig is made of cast steel with a base 8 in. by 6 in. and is 7 in. high. This height is sufficient to permit any necessary vertical adjustment of the



This Jig Is Used for Grinding Air Pump Valve Bushings on a Heald Machine

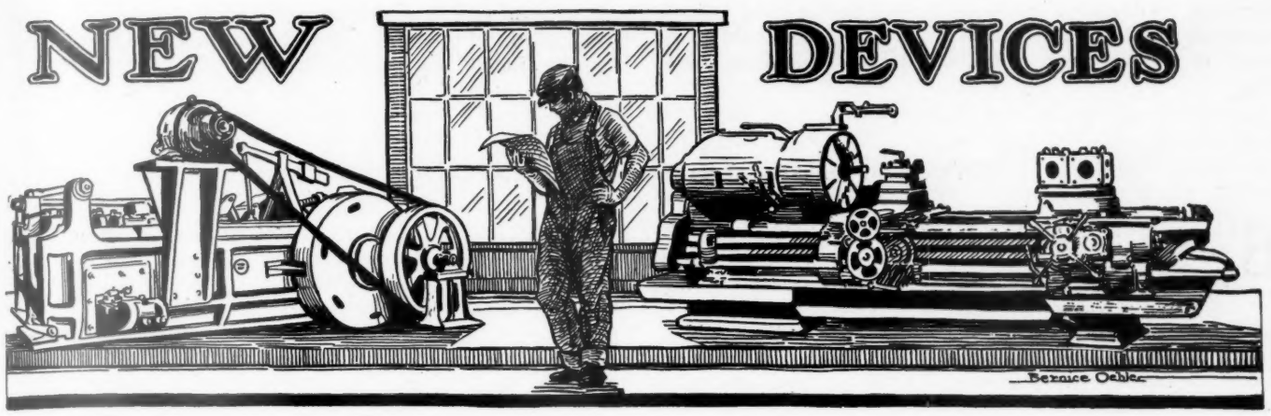
table. A groove 3 in. wide and having a 45 deg. slope is machined across the top for holding the work. As shown in the illustration, the work to be ground is placed in this groove and is then clamped down to the jig by bolts, the heads of which fit in slots machined on the side for this purpose. The jig itself is secured to the table by means of



View Showing the Jig Holding a Valve Bushing That Is Being Finished on the Inside

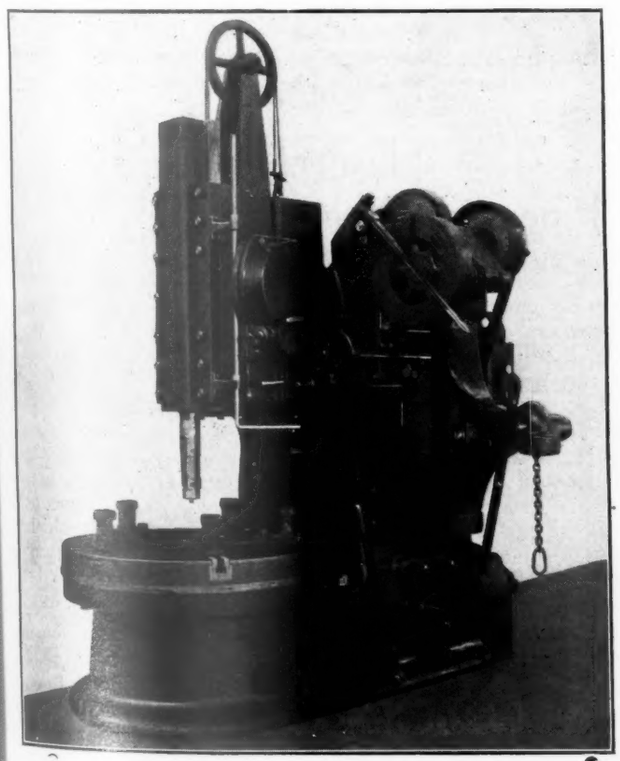
a single bolt. The head of this bolt fits in a T-slot in the table and extends up through the base of the jig. The jig is prevented from turning by bolting a block on the table against the side or back.

The work is removed and replaced in the jig by loosening or tightening the nuts on the clamping bolts.



Car Wheel Borer with Labor-Saving Features

THE Betts Machine Works of the Consolidated Machine Tool Corporation, Rochester, N. Y., has developed a new design of car wheel boring machine with several new features of labor-saving value. These features include an automatic chuck and independent power rapid traverse to both the boring and facing spindles. This enables the workman to perform all the operations that are necessary with the least amount of manual labor and in the quickest possible time. The controls and levers are placed within easy reach of the operator and any desired adjustments of the tool may be made easily and quickly.



A Car Wheel Borer Equipped with an Automatic Chuck and Power Traverse

The boring spindle is of heavy rectangular section. The facing spindle is self-contained in the frame of the machine and has a bearing in a square guide on the under side of the frame, thereby supporting the facing tool close to the cut. The facing tool slide has sufficient vertical adjustment to accommodate the varying heights of wheel hubs. The power rapid traverse of the boring and facing spindles is independent so that rapid traverse may be used on one while feed is being used on the other. This feature allows the operator quickly to raise the spindle by power when the wheel is bored. This is done by simply throwing the rapid traverse lever in the direction the operator desires to move the spindle.

Six feeds are provided to both heads. These feeds are obtained through selective sliding steel gears which may be changed while the machine is running. When the roughing cutter has passed through the wheel, the operator can throw the proper feed lever, thereby instantly throwing in the finishing feed without stopping the table. Two-in-one boring tools can be used to the greatest advantage. The boring spindle is also equipped with a counterbalance weight so that it may be raised and lowered by means of a crank handle. This is a convenient arrangement in case it is desired to make close adjustment. When the spindle is elevated, this counterbalance weight enters a chamber in the frame and is, therefore, out of the way of the operator. In the design of the machine the manufacturers devoted a great deal of time and attention to improvement for facilitating the work.

The automatic chuck is controlled by a reversing friction clutch so that it is unnecessary to stop or reverse the motor when closing or opening the chuck. When the driving clutch is thrown in, the table starts to rotate and the jaws move towards the center, gripping the wheels with the full driving force of the motor, and the heavier the cut the tighter the jaws will grip. When the bore is finished, the table is stopped by means of a band brake operated by a foot treadle and the clutch is then thrown to the reverse direction, causing the jaws to open instantly, without stopping the motor. This band brake also serves the purpose of enabling the operator to stop the table and caliper the bore of the wheel without any danger whatever of loosening the grip of the jaws on the wheel. The treadle is located at the side of the machine in a convenient position for the operator.

Four table speeds in geometrical progression are provided and are obtained through hardened steel sliding gears located in the base of the frame where they run in a bath of oil. Either the mechanical hoist, as shown in the illustration, or the pneumatic hoist may be supplied. In case the mechanical hoist is used, it is driven by a belt from the main drive shaft so that only one motor is required per

machine. All control levers are located on the right hand or operating side of the machine where they are within easy reach of the workman at all times. This machine has a capacity for boring wheels up to 42 in. in diameter, the table being 52 in. in diameter. It can be furnished either with or without a facing tool for finishing the hubs.

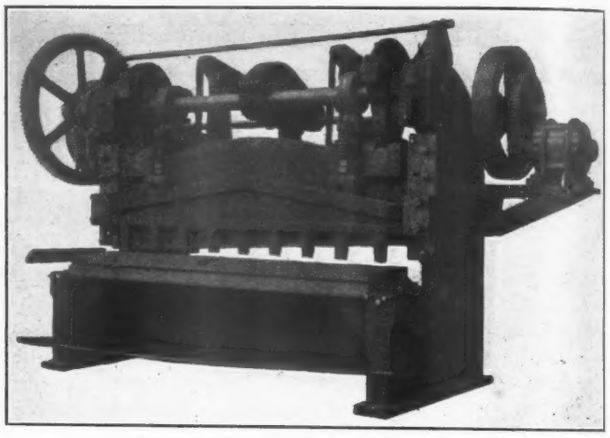
Power Squaring Shear with Overhead Drive

BERTSCH & COMPANY, Cambridge City, Ind., has recently begun the manufacture of a power squaring shear equipped with an automatic hold-down which is self-adjusting for sheets of different thicknesses. This hold-down is so constructed that the operator can see the shearing line at any point on the table. The machine is operated at about 35 strokes per minute by a 10-hp. constant speed motor running at about 1,100 r. p. m. The principal castings used in its construction, including the gears, are made of semi-steel.

The frame bearings for the eccentric shaft have split boxes which may be adjusted to take up wear. This arrangement also permits the removal of the eccentric shaft without dismantling the frames. The crosshead bearings are provided with gibs to take the wear and also to keep the blades in proper alinement. The blades have four cutting edges that may be reversed as desired. The table is adjustable to allow for regrinding the blades.

One of the special features of the machine is the arrangement of the center bearing on the back side of the crosshead. This makes the machine more rigid and tends to keep the blades in alinement. This bearing is held by a heavy cross-tie casting bolted to the frame and is made adjustable to take up wear.

This machine, known as the No. 4 overhead driven power squaring shear, has a 6-in. throat and is 8 ft. 4 in. between housings, with a capacity to cut ¼-in. and lighter soft steel sheets up to 8 ft. in length. Center bearings are provided for the crosshead, eccentric shaft and driving shaft. An automatic clutch with hardened steel jaws, and cut gears, are also important features of the design. A full set of front, rear and side gages is furnished with the machine. Its weight is approximately 25,000 lb.



A Power Squaring Shear of Rigid Construction

Machine for Bending Pipe and Tubing

A PIPE bending machine capable of bending brass, copper or steel tubing without the liability of crimping or flattening has recently been developed by the Pedrick Tool & Machine Company, Philadelphia, Pa.

As shown by the illustration, the device is of comparatively simple construction. A face plate, with gear teeth cut on its periphery, is made to revolve in an outer casing. A hand lever is attached to a pinion which meshes with the face plate, thereby increasing the leverage so that its operation requires little manual effort. A flat steel piece containing a number of holes for the adjustment of the resistance stud, is attached to the outer casting in such a manner that it does not move with the face plate. An upright stud fastened to the face plate is adjusted radially by a set screw. This stud is provided with a roller in order to reduce the friction of carrying the pipe around the form.

Pipe-Bending Machine with Grooved Roll in Place

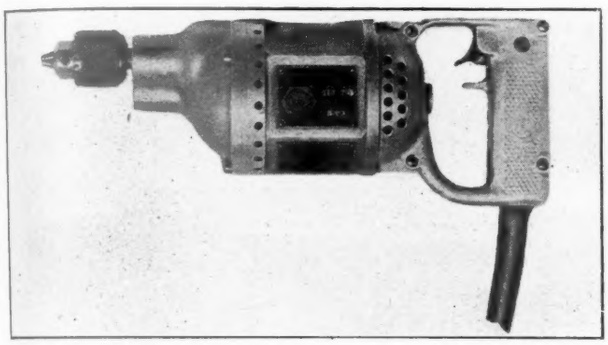
Located in the center of the machine is another stud over which are slipped the grooved rolls of the desired size. These rolls are made with various sized grooves to suit the diameter of the pipe or tubing to be bent and also in various radii in order to obtain the shape desired. The degree or angle of the bend is determined by the arc through which the face plate is moved. As the machine can be set to any bending radius, the number of identical shapes that can be made is practically unlimited.

The machine may be bolted to a stand, bench or stanchion and it can handle any length of pipe. Rolls can be used that will take all sizes up to 4 in. in diameter. Short pieces are easy to handle and this permits cutting to length, threading if necessary, and then bending to the desired radius.

Where the tubing is of heavy material with walls approximately as thick as ordinary wrought iron and steel pipe, bending is not a difficult problem, but anyone who has attempted to bend thin tubing knows the ease with which it is dented, crimped or flattened. It has been the usual practice to fill such tubing with sand, resin or some other reinforcing material to prevent such trouble, but this method has not always been satisfactory. It is claimed by the manufacturers that this machine will eliminate any liability of undesirable distortion.

Two Electric Hand Tool Developments

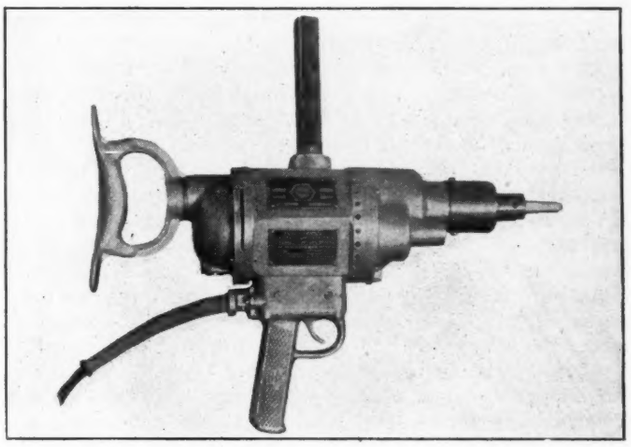
TWO developments in the adaptation of electric driven hand tools to railroad shop work are shown in the illustrations. The tools are manufactured by the Black & Decker Company, Baltimore, Md. One is a portable elec-



Black & Decker Portable Electric Drill

tric drill with a capacity for handling any size drill up to 5/16 in. in steel. This drill is similar in design to the Black & Decker ¼-in. drill, but has a more powerful motor and other parts in proportion to its size. It is equipped with a three-jaw gear nut chuck for straight shank drill bits. It weighs seven pounds and has a no load speed of 1,400 r.p.m. It is equipped with pistol grip and trigger switch.

The other tool is known as the No. 3 electric screw driver and socket wrench. The tool has been designed for heavy production work and for driving large wood screws, lag screws, and running up nuts on large bolts. The spindle is equipped with a positive clutch which automatically disengages when the forward pressure on the tool is released. The patented pistol grip and trigger switch, as shown in the



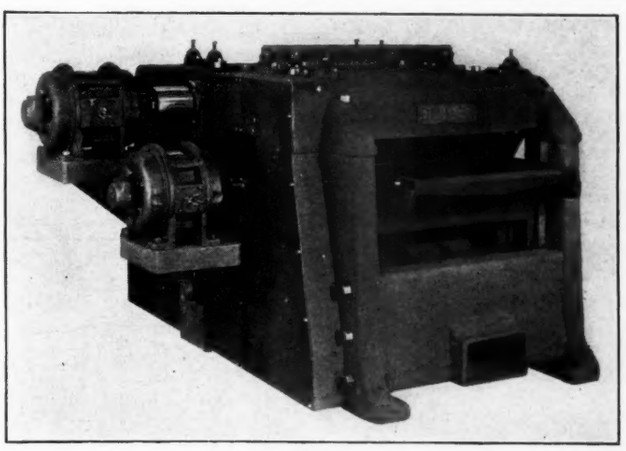
Portable Electric Screw Driver and Socket Wrench

illustration, is standard equipment on this tool. A universal motor is used to furnish the power and it can be supplied for all standard voltages up to 250 volts.

A Double Surfacer for Heavy Production

AS the result of a careful study of the requirements of a production surfacing machine, the Oliver Machinery Company, Grand Rapids, Mich., has developed a surfacer which is intended to give continuous service under high speeds for finishing work, as well as under heavy duty high speed roughing cuts. This machine is built in two sizes to surface simultaneously two sides of work up to 30 in. or 36 in. wide and up to 8 in. thick, at four rates of speed; namely, 26 ft., 46 ft., 72 ft. and 108 ft. per min. The top cylinder will take cuts up to ¾ in. thick and the bottom cylinder will take cuts up to ⅛ in. thick. The bottom cylinder may be lowered below the bed line, allowing the machine to be used as a single surfacer if desired. Pieces as short as 6 in. when feeding continuously and as short as 21 in. when feeding one at a time may be surfaced without dubbing the ends. Sectional infeed rolls and a sectional chip breaker are regularly furnished with 2-in. sections to enable many narrow strips to be surfaced simultaneously, thus increasing the production of the machine. The knives of the top cylinder can be quickly jointed without stopping the machine assuring greater production hours. This is also an improvement in the design of the machine on account of the time it formerly required to do this work.

An exclusive feature of this machine is the improved design of the pressure bars and outfeed pressure plate. This improvement eliminates dubbing the ends of the work or causing wavy cuts and thus assures uniform thickness. The bearings of the feed system are of a special alloy anti-friction bronze and are easily replaceable. Two double-row ball bearings are used at each end of both the top and bottom cylinders, with a distance collar and large lubricating chamber. This arrangement tends to minimize friction and to resist any bounding tendency of the cylinders. The Alemite system of lubrication is used for all bearings. A unit system of construction is used in which all the major parts with



Improved Surfacing Machine Designed for Continuous Service at High Speeds

their accessories are assembled together and located in the machine as a unit. All moving parts are enclosed and guarded.

The power hoist for the bed has an automatic release to eliminate any possibility of damage due to the operator's neglect. The bottom cylinder housing has a self-contained bracket supporting the table, on which the bottom cylinder

yoke slides out for quick setting and jointing, and for grinding the knives. Grinding can be done without removing the cylinder from the machine. A built-in shaving chute directs shavings from the bottom cylinder towards the rear of the machine and provision has been made for an exhaust connection.

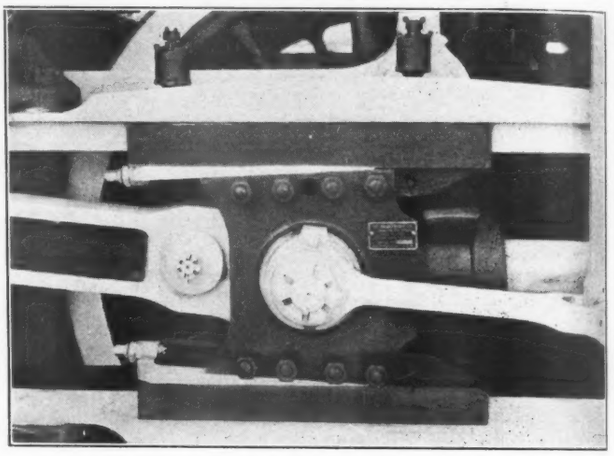
Improvements in the Rogatchoff Adjustable Cross-head

CONTINUED and extended use on heavy freight and passenger locomotives of the adjustable crosshead made by the Rogatchoff Company, Baltimore, Md., has shown the possibility of some small improvements in the details of construction, which have been incorporated in those lately applied. The square nut on the inner end of the wedge bolt is now fitted snugly with a 12-in. wrench fit, and after it has been applied, the extended end is upset, as indicated in the detail drawing. After the wedge bolt and wedge have been assembled and the outer hexagon nuts adjusted and locked, a washer with a square hole is slipped over the end of the bolt and electrically welded in place. Its consequently is impossible for the locks nuts to come off and be lost.

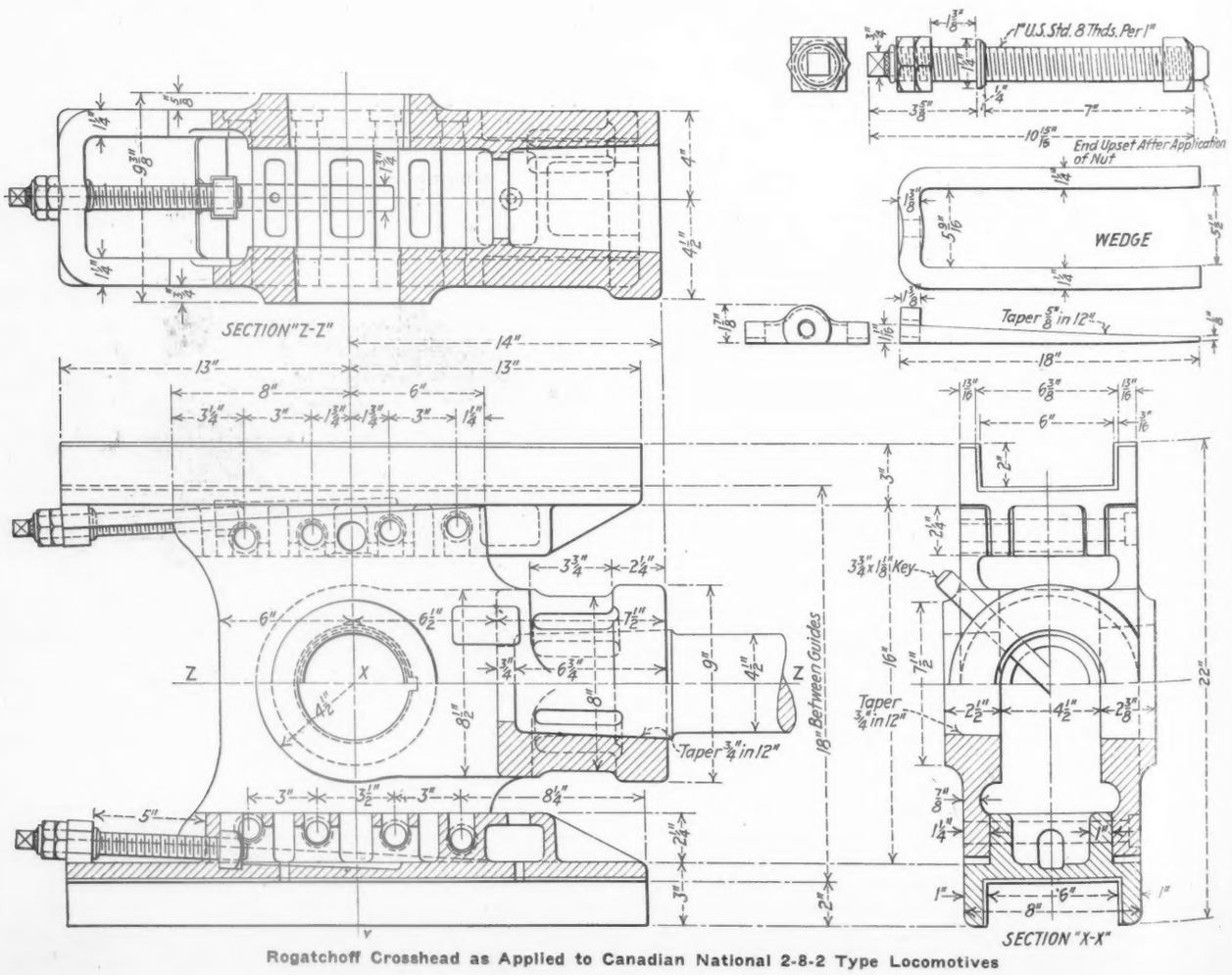
As now made, the adjusting feature has been rendered practically fool-proof. Even though the bolt should be turned the wrong way and left loose, it cannot come apart.

After the lost motion has been taken up by the wedge and the slipper and crosshead body have been locked by the through bolts, the wedge is then no longer depended upon.

The portion of the shoes which fits between the crosshead sides is now machined with straight parallel sides instead of tapered sides, as employed on early installations. No fundamental modifications, however, have been found necessary to improve the adjusting features, which have been used for some time.



Installation of the Rogatchoff Crosshead Showing Wedges and Shoe Bolts



Rogatchoff Crosshead as Applied to Canadian National 2-8-2 Type Locomotives

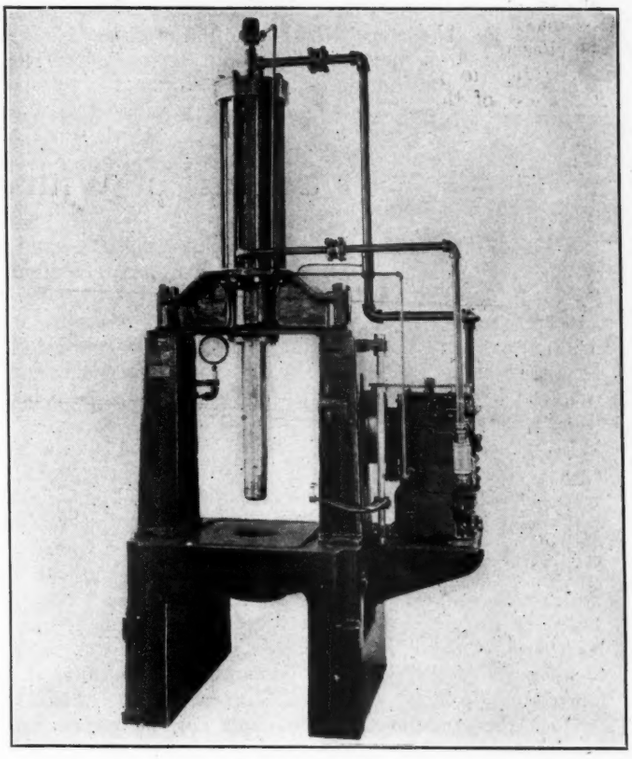
A Two-Column Hydraulic Press

THE Oilgear Company, Milwaukee, Wis., has announced a new line of self-contained, two-column hydraulic presses. These presses are built in several sizes, ranging from 15 to 50 tons' capacity and with the platen placed either 14 in. or 30 in. from the floor. The daylight space, width between the columns, and stroke of the ram are dimensioned to suit the requirements of a variety of work. These presses are equipped with a pump having a maximum delivery of 3,060 cu. in. of oil per min. and a maximum pressure of 1,000 lb. per sq. in. Several control mechanisms can be furnished for the pump, such as a plain hand control, as shown in the illustration, foot treadle or semi-automatic control. In all cases a single-acting lever gives instant control of rapid advance and return of the ram, and also controls the pressing speeds regardless of the resistance.

A differential quick advance to the rame can be obtained with either a hand lever or foot treadle control, which will allow the ram to be advanced to the work at double the pressing speed. The pump is so protected that the ram may be run against a positive stop without injury.

These presses have been designed for broaching, assembling, die work, forming, embossing, stacking, straightening and miscellaneous work where pressing action is required. One of their features is that the ram may be run against the work to any predetermined pressure and held at that pressure indefinitely, without pulsation.

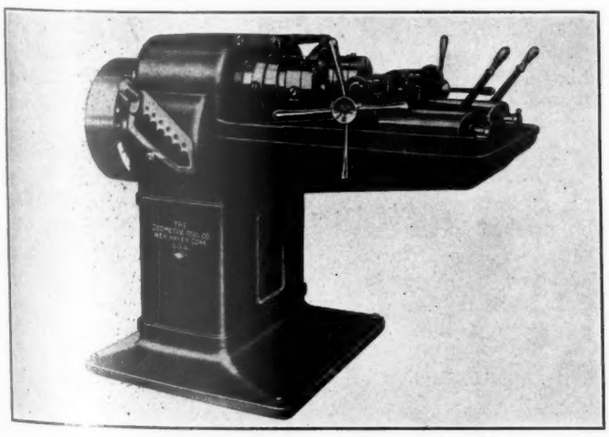
The principal claims are sensitiveness of control and a smooth, positive motion of the ram, all in a self-contained unit requiring no accumulator. There are no expensive operating valves. The press can be driven from any constant speed source of power and is fully protected against damage from stalling or over-running.



Self-Contained Hydraulic Press Built in Sizes Varying from 15 to 20 Tons

A Double Spindle Threading Machine

A MACHINE designed primarily for threading work in which the threading time for both pieces is sufficient to allow the operator to check and start a second piece while the first is being completed, is now manufactured by the Geometric Tool Company, New Haven, Conn. A number of threading combinations are possible with this machine. Both spindles may be fitted with die heads for external threading only or with collapsing taps for internal threading, or one spindle may carry a die head and the other a tap for handling work which requires both an external and internal thread. The same combination may also be employed for separate external and internal threading whenever work of such character is required.



Geometric Machine With a Wide Range of Threading Combinations

The bed of the machine consists of a casting, carrying the two spindles, which are mounted in large bronze bearings. The spindles are driven by a single pulley, located at the rear of the machine, but they can be driven independently by means of the change gear levers at either side of the machine. Each carriage is fitted with a two-jaw chuck. The chuck is operated by a hand wheel, and special bushings or holders can be furnished to suit various classes of work. An adjustable swinging gage on the side of the carriage provides an accurate means of setting the work for a predetermined length of thread. An adjustable stop on the trip rod ahead of the carriage governs the opening of the die head and the length of the thread to be cut. The adjustable stop back of the carriage controls the closing of the die head.

Both spindles are operated and controlled in exactly the same manner. This facilitates the operation of the machine for the standpoint of production.

A single geared pump, driven from the main shaft by bevel gears and a flexible shaft, forces oil from the reservoir through the spindles and die heads against the work. When equipped with the collapsing tap or high speed tapping device, the oil is fed through pipes on the outside of the machine. The lubricating system may be easily removed for cleaning and inspection.

The change gear levers on the sides of the machine control the spindle speeds independently, and may be set to furnish the proper speeds for the threads being cut. The speed

given will be found satisfactory for the average run of work, but may be varied to suit special conditions. A safe cutting speed for any diameter is one which will insure the maximum production without causing excessive wear on the chasers. If the speed for which the machine is designed is too fast to permit this, it should be run more slowly, regardless of the index.

This machine will cut threads of the following diameters: ¾, ⅞, 1, 1⅛, 1¼, 1⅜ and 1½ in. The greatest cutting length at which the swinging gage can be set at one time is 9 in. With resettings, a length of 14 in. may be obtained. The floor space required is 48 in. by 65 in. The speed of the countershaft is 296 r.p.m., and the net weight of the machine, 2,165 lb.

Solder Pot With Automatic Heat Control

AN electric solder pot with automatic heat control has been added to the line of devices manufactured by J. D. Wallace & Co., Chicago, Ill. The automatic control simplifies the problem of heating babbitt, white metal, wax and other materials that are slow conductors of heat. The main objective in its design is to overcome oxidation and it so operates that when the solder has been heated to 600 deg. F., an automatic control prevents a further rise in temperature. This control is an adaptation of the principle used in the steam gage. A volatile substance, which is very sensitive to heat, actuates a Bourden tube, which makes and breaks the electric circuit, thus controlling the temperature of the contents of the pot.

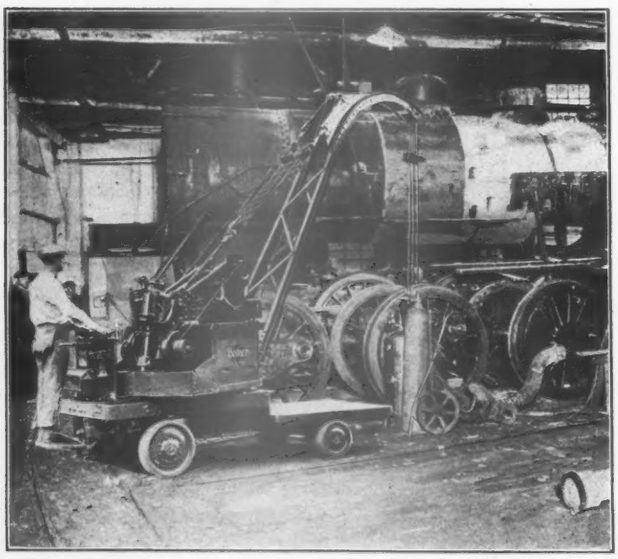
The pot will accommodate 15 lb. of solder and will heat this amount to 600 deg. F. in 20 to 25 min. Its quick action is due to the fact that a 900-watt heating element is built around the entire container and heat is thus applied to all parts of the sides and bottom of the container simultaneously.

Once the container is filled and current turned on, it requires no attention until refilling is necessary. The pot weighs only 13 lb. and operates on either 110-volt or 220-volt alternating or direct current.

This Solder Pot Eliminates Oxidation by Thermostatic Temperature Control

Locomotive Type Crane

THE locomotive type crane, made by the Baker R & L Company, Cleveland, Ohio, has been completely redesigned for railroad use, the new crane, shown in the illustration, having a wide field of usefulness not only in enginehouses but in all railroad departments where heavy material must be handled without the aid of overhead traveling cranes. With an 8-ft. boom and 60-in. wheelbase the new crane may also be operated inside a standard box car and thus greatly reduce the number of laborers required for loading and unloading these cars.



A Baker Locomotive Type Crane Speeds Heavy Repair Work in an Enginehouse

For enginehouse use the new Baker crane can be provided with a standard 12-ft. or longer boom up to 19 ft. With the latter length a lift of 192 in. can be obtained at a 95-in. radius and the crane is therefore suitable for reaching over the tops of locomotives and removing front doors, dome casings or covers, dry pipes, air compressors, or other parts high up on the locomotive which ordinarily require the effort of several men and more or less laborious work to remove or apply.

A short, auxiliary boom can be furnished when desired for working underneath the running boards, greatly facilitating the removal of heavy rods, crossheads, pistons, etc., which on modern locomotives have far outgrown the point where they can be readily put up by hand. When not in use this auxiliary boom can be folded up out of the way.

The special feature of this crane is that all of its movements are electrically driven with one motor for propelling the trucks, a second for swiveling the crane and a third which drives the main hoist. The main hoist consists of two drums, one for lifting the hook and the other for racking the boom. Power is applied to either of these drums by means of magnetically-operated clutches.

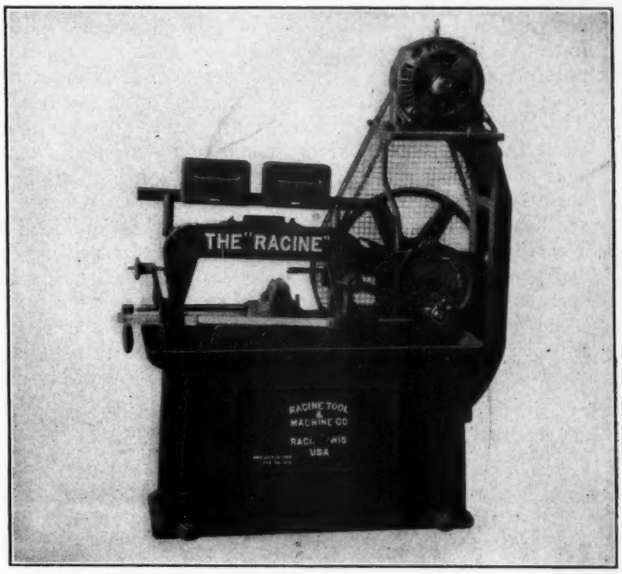
The rated capacity of the crane is 3,000 lb. at a 7 ft. radius, the hoisting speed at that load being 7 ft. per min. and the traveling speed 265 ft. per min. As shown in the illustration, the boom is long enough to perform practically all the heavy lifting, such as side rods, air pump and main reservoir, around a locomotive.

A Hack Saw Redesigned for Motor Drive

THE Racine Tool & Machine Company, Racine, Wis., has redesigned its high speed hack saw, known as No. 2A, for operation by an electric motor. This machine is already in use in a number of railroad shops. With the exception of the driving mechanism, it is of the same construction as the regular No. 2A type. As shown in the illustration, the motor sets on a platform that is part of a bracket attached to the end of the bed. The saw is driven by a chain and sprocket wheel directly connected to the motor. The driving mechanism is entirely enclosed by a wire mesh safety guard.

The machine is equipped with a special three-speed transmission, which provides the proper speeds for cutting any kind of material. It is equipped with a quick-acting vise, which swivels on the table bed and grips the stock close up to the saw blade, thus enabling the operator to cut short pieces at any desired angle. As shown in the illustration, the vise is operated by means of a handle that extends beyond the end of the machine, which makes it easily accessible.

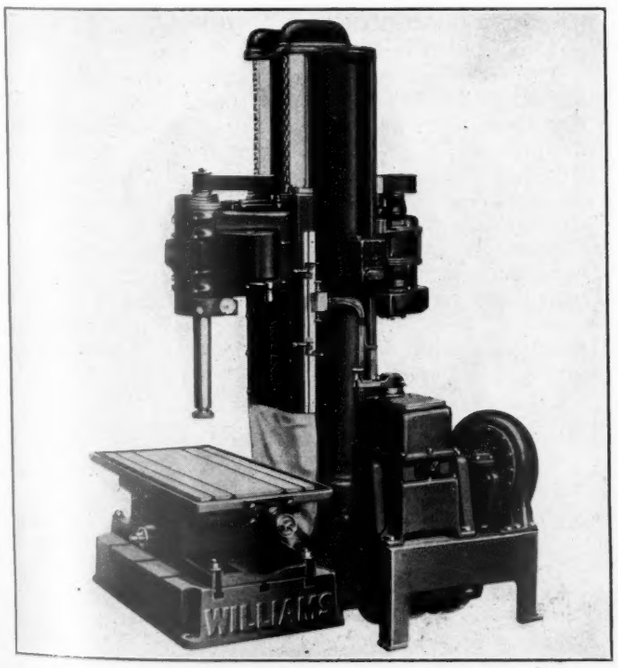
The lift for the non-cutting stroke is secured by an automatic device, which prevents the blade from dragging back, no matter how great the pressure. The blade cuts through the material by gravity which tends to prevent injury to the teeth. A positive circulating pump applies a cutting compound to the blade and an automatic stop throws out the clutch when the material is cut through. There are only ten moving parts in the machine. Its actual capacity is 6½ in. by 6½ in. and it uses blades from 10 in. to 14 in. in length. The floor space required is 30 in. by 44 in. and its net weight is 710 lb.



Belt Driven Hack Saw Which Has Been Redesigned for Motor Operation

Internal Grinder Equipped with Universal Table

A VERTICAL internal grinder equipped with a suction fan for removing chips and dust, a dialing mechanism for adjusting the eccentrics and a universal table, has been placed upon the market by the Hi-Way Service Company, South Bend, Ind. This grinder is known as the Williams vertical cylinder grinder. The head consists of a unit casting and contains all the working parts, which are lubricated by oil bath, oil vapor and oilers. The arbor is made up of two eccentrics, one within the other, giving the grinding spindle a planetary adjustment for feeding the wheel to the work. It is driven through a worm and worm wheel by a two-speed motor that is mounted on the side of the head.



Vertical Grinder Driven by a Two-Horsepower Motor Mounted In the Rear of the Head

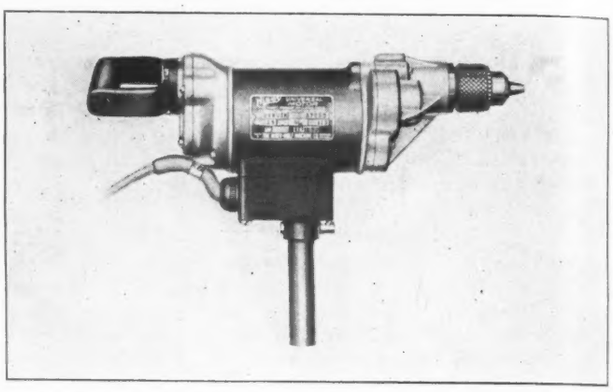
The grinding spindle rotates at a constant speed of 7,000 r.p.m. and is carried on a double row of annular ball bearings. These bearings carry the weight of the shaft and also take care of the thrust load. The center bearings are of bronze. The lower bearing at the grinding wheel end is made from high-grade bronze, tapering and adjustable to take up the wear. This spindle is driven from a two-horsepower vertical motor mounted on the rear of the head, through a flexible idler that maintains uniform belt tension. Various spindle speeds are provided by interchangeable pulleys on the wheel spindle and motor shaft, enabling the use of large or small diameter grinding wheels for grinding holes of different size.

This unit head and power plant can travel up and down between heavy columns at the will of the operator. The columns are provided with V-ways and heavy gibs that are counterbalanced by weights in each column. The column is of twin design, cast together at top and bottom, making a stiff and rigid casting. The ways provided for the head travel are cast integral, machined and hand scraped to a perfect fit.

The base is of heavy construction and supports the twin column and universal table. In grinding large single cylinders, the universal table can be removed from the T-slotted base and the work clamped direct onto the base which is also provided with slots.

Side Handle Portable Drill

A HIGH-SPEED portable drill suitable for wood and metal drilling has recently been placed on the market by the Hisey-Wolf Machine Company, Cincinnati, Ohio. The machine is of sturdy construction, small and compact, and is as light in weight as good practice will permit. All parts are easily accessible, which was made an important feature in its design in order to reduce maintenance costs. All bearing surfaces are equipped with ball bearings. The lubrication for all the bearings, gears and other moving parts in the gear end of the machine is supplied from the gear transmission case, while the ball bearing on the top head is packed with grease. All gears are machined and are heat treated in order to secure toughness and long life. The illustration shows the type designed for drilling hard metal, where a slow speed is often preferred. It can be operated on either 115 or 230 volts and runs at a no load speed of 1,250 r. p. m. At normal load, its speed is 760 r. p. m. and it has a capacity in steel of 5/16 in. It has an overall length of 14 in. and weighs 12 lb. in working order. A quick cable connector permits the making of cable repairs and renewals without dismantling the machine.



A Portable Electric Drill Adapted for Wood and Metal

Hose Coupling and Spider Hose Mender

IN view of the great amount of compressed air used in railroad shops, enginehouses and car repair tracks it is plain that this air should be used as economically as possible. Moreover the efficient operation of thousands of pneumatic tools is dependent on the supply of an adequate amount of compressed air at the pressure required to operate the tools. A leaky hose, if it occurs too often, is the cause of considerable waste and unnecessary expense.

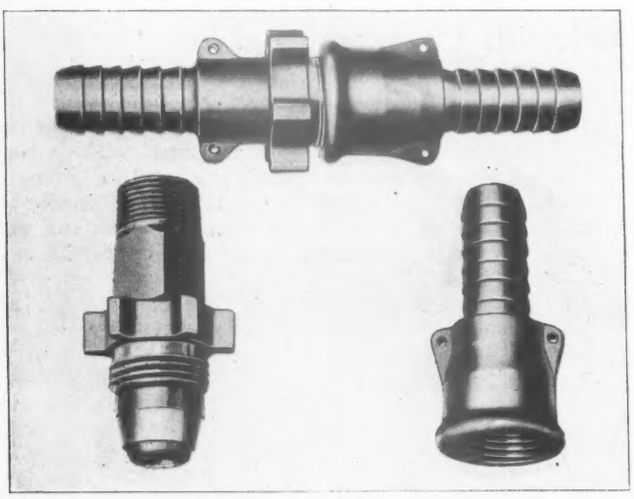


Fig. 1—Lowney Hose Coupling—Taper Gasket on Male End

Realizing these facts and their relation to tight hose connection fittings the Gustin-Bacon Manufacturing Company, Kansas City, Mo., has developed a coupling and a Spider hose mender designed to be positively air tight. The coupling is a simple, positive connection without springs or locking teeth, the connection being made and wear taken up by turning a swivel nut.

Referring to Fig. 1 the construction of the coupling and its various parts will be evident. The gasket fits in a taper groove in the male end and turning the swivel nut forces the gasket against the shoulder in the female end. The gasket is said to be easily applied and not subject to blowing out. Special provision is made to prevent the couplings themselves from blowing out of the hose by a method of clamping shown in Fig. 2.

The G-B Spider hose member, that is shown below in Fig. 2 has been designed as a simple, rapid and effective method of splicing air hose or joining the ends after a defective piece has been cut out. In applying this fitting all that is necessary is to cut the ends of the hose square, lubricate the nipple ends of the mender, slip the hose over the nipples and hammer the points into the hose. It is said that this mender will not leak or pull out under high pressures. An important advantage of this device is that on account of its short length there is practically no interference with the flexibility of the hose. This coupling and mender has been recommended as a useful adjunct to the air line repair man's supply of material for making hasty repairs.

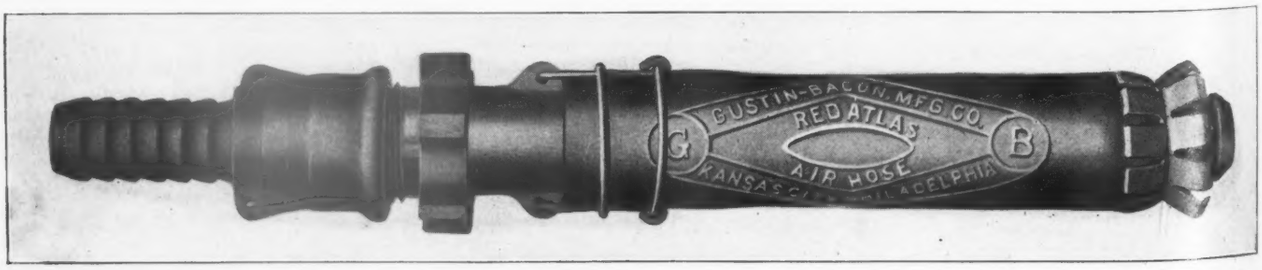


Fig. 2—View Showing Wire Clamp Arrangement and "Spider" Hose Mender

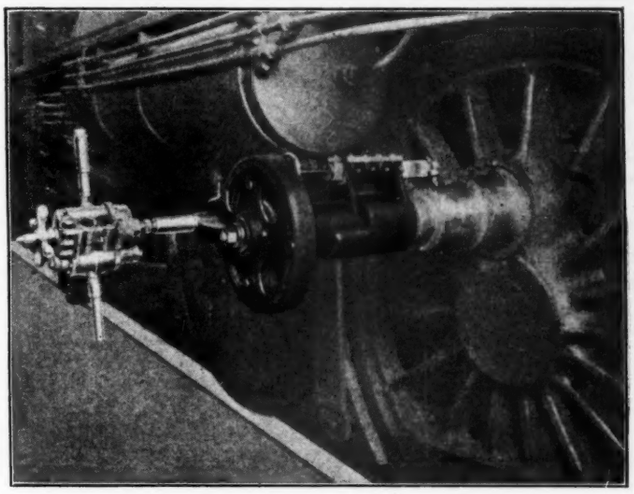
Portable Crank Pin Turning Machine

THE illustration shows a portable crank pin turning machine bolted to the end of a crank pin on a locomotive driving wheel. The H. B. Underwood Corporation, Philadelphia, Pa., manufacturers of this device, have developed this method of attaching the machine to the pin to assure perfect alignment of the cutting tool in respect to the axis of rotation. It is made in two sizes; one with a capacity for turning pins from 4 in. to 10 in. in diameter, with an extension slide up to 16 in. in length, and the other with a capacity for pins from 6 in. to 13½ in. in diameter and a 21-in. extension slide.

One of the advantages claimed for this machine is that the cutting tool and work is in full view of the operator at all times. The tool is fed longitudinally by a star wheel actuated feed screw. The feed is automatic, variable, and can be reversed as desired. The equipment, as shown in the illustration, is comparatively light and well balanced, which tends to insure a steady cutting speed and accurate work.

Its operation is simple. The stationary spindle is fastened to the end of the crank pin and the slide that holds the tool is revolved around the spindle. An adapter bushing aligns the tool concentric with the original center. Special adapter bushings may also be made for this machine to suit other types of work. A revolving sleeve, mounted on the spindle, carries the tool slide to which the cutting tool is fastened by means of a tool post and clamp screws. It is driven by machine-cut spur gearing, and can be adapted either for air, motor, pulley or hand power drive. The net weights of the two sizes of this machine are 411 lb. and 668 lb. respectively.

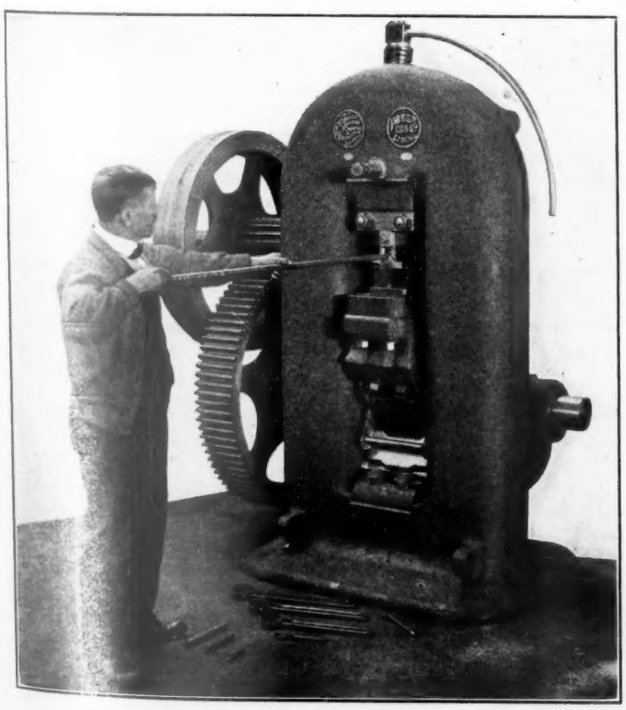
This crank pin turning machine has been successfully used in a large number of railroad shops. On account of its comparatively light weight it can be easily transported to any place desired around the shop and adjusted on the crank pin.



Portable Crank Pin Turning Machine Operated by Air Motor

Press for Producing Staybolt Blanks

THE illustration shows a coining press built by the Ferracute Machine Company, Bridgeton, N. J., fitted with dies and attachments required to produce staybolt blanks. The square head is formed and the bolt blank is cut from the end of the bar in the same operation. The average production for this machine is at a rate of 30 blanks per minute.



Making ⅞-inch Staybolt Blanks from a Steel Bar

The press is of compact construction, the frame being constructed from a solid casting with but 14 in. between the columns. The stroke of the press is 2 in. The ram is forced upward by the action of steel toggles which are actuated by a 6-in. steel shaft at the back of the press. The head, to which the upper die is attached, can be adjusted downward as much as ½ in. by means of a wedge adjustment operated by a screw. A bolt at the top of the press keeps the head firmly up against the frame. The spring shown in the illustration has sufficient tension to take the entire weight of the head when operating the wedge adjustment. The forming dies are V-shaped and there is an adjustable gage at the back of the press so that bolt blanks of various lengths may be cut off.

The operator is shown in the act of making ⅞-in. staybolt blanks from a steel bar of that diameter.

THE PENSIONERS of the Canadian Pacific Railway, now numbering 1,182, receive an average pension of $35.92 a month. Each pension includes a bonus, which has been allowed monthly, since May 1, 1919, on account of the abnormal increase in the cost of living. For 20 months, this bonus was 25 per cent, but since the beginning of this year, it has been 20 per cent. These and other facts about the pensioners have been given out in connection with an account of the twentieth anniversary of the establishment of the pension system. Employees of the company now number about 90,000, more than four times as many as were in the service in 1903, and the total payments by the company now amount to more than $500,000 a year. President E. W. Beatty, reviewing the 20 years' history, speaks of the pension as an inherent right of employees who have given faithful service to the company, and he classes this beneficial arrangement as an important aid in shaping the high standard of co-operation that exists between all branches of the company's service.

GENERAL NEWS

The shops of the Wabash Railway at Decatur, Ill., were damaged by fire on February 26, four buildings being practically destroyed; estimated loss $250,000.

C. E. Brooks, chief of motive power of the Canadian National Railways, has arrived in Sweden for an inspection of the Swedish railways and railway equipment manufacturing plants.

Motor passenger cars are now in use on 157 railroads in this country, according to a compilation made by the National Automobile Chamber of Commerce; about four times as many roads as were shown on a list made one year ago.

The proposal to amend Car Service Rule 12 was adopted by the A. R. A. and the amended rule became effective March 1, 1924. It now reads that "the placing of advertisements or banners of any kind, at any time, upon passenger or freight cars, or locomotives, is prohibited."

Henry La Rue, formerly master car builder of the Chicago, Rock Island & Pacific, has resigned as senior inspector of equipment of the Bureau of Valuation of the Interstate Commerce Commission, with office at Washington, D. C., to devote his time to personal affairs.

The Department of the Interior has issued Bulletin No. 223, in which the results of 36 combustion tests made on a 468-hp. boiler, fired with pulverized coal, at a power station of the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., are given. The object of the tests was to obtain authoritative results of the performance of pulverized coal under various conditions of furnace operation as well as with coal of different fineness and moisture content.

The Interstate Commerce Commission's monthly report to the Senate on the condition of railroad equipment shows that during January, 102,676 freight cars were inspected by its Bureau of Safety of which 4.1 per cent were found defective and 1,766 passenger cars, of which 1.2 per cent were found defective. The Bureau of Locomotive Inspection during the month inspected 5,311 locomotives, of which 3,073 or 58 per cent were found defective and 737 were ordered out of service. There were 85 accidents during the month caused by the failure of some part or appurtenance of the locomotive or tender, in which 6 were killed and 93 were injured.

Wage Statistics for November

For the month of November, Class I railroads reported to the Interstate Commerce Commission 1,899,545 employees, an increase of 79,082 or 4.3 per cent over the number reported for November, 1922. The total compensation increased $399,311 or 0.2 per cent. The overtime compensation was $10,039,041 greater in November, 1922. The number of employees reported for the first eleven months of the year 1923 averages 1,887,590, an increase of 255,386 or 15.6 per cent as compared with 1922. The total compensation paid to employees of Class I railroads increased $386,990,898 or 16.0 per cent in this same period.

Santa Fe Organizes for Fuel Conservation

A fuel conservation organization has been established on the Atchison, Topeka & Santa Fe. The committee in charge consists of the fuel conservation engineer, four fuel supervisors covering the different general managers' territories and 14 division fuel supervisors. J. M. Nicholson, fuel conservation engineer, with headquarters at Topeka, Kan., is at the head of the work.

Safety Appliance Order Not to Be Revised

Following a conference of a committee representing the Bureau of Safety of the Interstate Commerce Commission, the Mechanical Division of the American Railway Association and the train service brotherhoods, called for the purpose of considering a revision of the commission's order of March 13, 1911, prescribing standards for safety appliances for equipment, to be submitted to the commission, it has been decided to leave the order in its present form.

Germany Gets Order for Locomotives for India

A locomotive manufacturer in Hanover, Germany, has secured an order for five locomotives from the government of India, according to a wireless dispatch from London to the New York Times. This order was placed in London by the High Commissioner for India who, however, had little choice in the awarding of the contract, since he had been instructed by the Indian legislature to place the order with the lowest bidder and the German bid was 40 per cent below that of the British bidder.

American Engineering Council

The organization of the American Engineering Council has been practically completed. This takes the place of the old association of the different engineering societies, known as the Federated American Engineering Societies. The constitution of the new organization contains a number of radical changes from that of the old Federation, of which the most outstanding is the provision for membership. It is now possible for technical sections or divisions of non-engineering organizations to be admitted to membership, as well as alumni associations of engineering schools and sections of non-member national societies. None of these were included under the constitution of the Federated American Engineering Societies. Another feature is that the membership is now restricted to organizations in the United States.

LOCOMOTIVE AND FREIGHT CAR REPAIR SITUATION

	Locomotives					Freight cars					
Date 1923	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. repairs over 24 hr.	Per cent req. repairs over 24 hr.	Date 1923	No. freight cars on line	Cars awaiting heavy repairs	Cars awaiting light repairs	Total cars awaiting repairs	Per cent of cars awaiting repairs
January 1	64,453	48,905	576	13,587	21.1	January 1	2,264,593	164,041	51,970	216,011	9.5
April 1	64,559	50,107	914	12,801	19.8	April 1	2,296,997	154,302	52,010	206,312	9.0
July 1	63,906	52,456	2,181	10,326	16.2	July 1	2,260,532	146,299	44,112	190,411	8.4
October 1	63,982	54,159	2,620	8,787	13.7	October 1	2,270,840	118,563	32,769	151,332	6.7
November 1	64,192	54,080	2,517	9,163	14.3	November 1	2,263,099	116,084	34,540	150,624	6.6
December 1	64,336	53,764	3,367	9,577	14.9	December 1	2,270,405	116,697	38,929	155,626	6.8
1924						1924					
January 1	64,406	54,031	5,061	9,395	14.6	January 1	2,279,363	118,653	39,522	158,175	6.9
						February 1	2,269,230	115,831	45,738	161,569	7.1

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8

Discontinuance of Bonus Hours

The Labor Board has ordered that Decision No. 222 and its addenda discontinue the allowance of a bonus hour to certain classes of employees engaged in night work. This decision was rendered in a dispute between the Railway Employees' Department, American Federation of Labor, and the Northern Pacific, the Great Northern, the Chicago, St. Paul, Minneapolis & Omaha, the Minneapolis, St. Paul & Sault Ste. Marie, the Minneapolis & St. Louis, and the Minnesota & International. On the question of whether certain classes, to whom the bonus hour had not previously been allowed, should be granted this allowance up to July 1, 1922, the board ordered against such an allowance. A dissenting opinion was filed by board member A. O. Wharton and a supporting opinion was filed by Chairman B. W. Hooper.—*Decision No. 2071.*

Trying to Beat Train to Crossing Negligence Sole Cause of Accident

In a crossing accident case there was evidence that the train which struck the automobile was moving very slowly, that the latter could have been stopped in four feet, that the brakeman's signals and yells to stop were seen and heard by occupants of the car, that the usual crossing sign was there, that three whistle blasts were blown and the automatic locomotive bell was ringing continuously. The District Court of Appeals, Eighth Circuit, holds that it was the negligence of the occupants of the automobile "and theirs alone, which caused the unfortunate accident, in attempting, as is so frequently done, to cross when a moving train is in sight within a short distance, hoping to make the crossing before the train reached it."—Engstrom v. Canadian Northern, 291 Fed. 736.

Alton Refuses to Recognize Federated Shop Crafts

The Chicago & Alton, in reply to an order by the Labor Board that it allow the Federated Shop Crafts to represent its shopmen, has sent a formal statement to the board declining, in substance, to comply with the order. The officers of the road declare that to return to the previous practice of dealing with the Federated Shop Crafts would open the way for a recurrence of a strike such as the one called by the national shop crafts organization in July, 1922. The reply reviews the dispute in detail. The trouble began, according to the statement, when the striking employees, returning to work, came into a majority over the new workers who had organized a "company association" of shopmen. The Alton claims that a valid agreement was entered into between the management and this association and that no change can be made until the time specified has expired; and that at no time in years have the relations between the management and the shopmen been as cordial as they have been since the formation of the "company association."

Water Glass Shields in Canada

The Board of Railway Commissioners for Canada has amended Clause 36 of its General Order No. 78, by substituting the following: "Water and Lubricator Glass Shields.—Water gage glass mountings on all locomotives must be protected by a strong cage made of aluminum, or brass metal, fitted with heavy reinforced plate glass shields, 3/8 in. thick, with an outlet pipe attached to the bottom of the water gage mounting, which will allow the flow of steam from broken gage glass to escape below the foot plate of the locomotive, or close to the foot place itself.

"These appurtenances must be so located as to insure a correct reading of the level of the water in the boiler at all times, and be in full view of both the engineer and fireman, and the lights so placed that there will be a clear and unobstructed view of the water in the mounting."

This change was made as the result of a petition filed on behalf of the Railway Association of Canada and the Brotherhood of Locomotive Firemen and Enginemen.

Japanese Railways Extend Time Limit on Improvement Program

The Japanese Department of Railways has, in view of the heavy expenses necessitated by the September quake, altered its ten-year construction and repair program recently adopted. The total amount of capital to be spent for the realization of the plan has not been changed, but the time limit on the program has been placed at eleven or twelve years.

The whole construction budget is given at 612,995,000 yen. Of this total 27,404,000 yen is to be set aside for the purchase of locomotives and cars. The credit for repairs and improvement is placed at 676,960,000 yen. Of the figure 150,127,000 yen is to be spent in purchasing locomotives and cars. The purchase of locomotives and cars is to be completed by 1928. The electrification of some trunk lines figures prominently in the altered program. The Department of Railways proposes to spend 81,000,000 yen for the installation of electric plants. Roughly 300,000,000 yen is to be used in replacing old rails.

Canadian National Considering B. & O. Shop Plan

A modified form of the Baltimore & Ohio plan, whereby shop employees co-operate with the management in securing greater efficiency, is likely to be soon given a trial on the Canadian National. Although no decision has yet been reached and the board of directors has not yet had an opportunity of studying the subject, some statements recently made in Winnipeg by Sir Henry Thornton, president of the C. N. R., indicate a trend in that direction.

It had been stated the day previous in a press despatch from Winnipeg that the Baltimore & Ohio plan would be introduced on the Canadian National in the near future, but on the day following Sir Henry denied this report. He added, however: "It is true that there is under consideration and discussion a scheme for co-operative shop working, but this scheme relates to shop practice and working conditions, and has for its object the mutual welfare of both the men and the company. There is no intention on the part of the Canadian National Railway System to part with any of the executive functions which are regarded as essential to the well-being of the property."

Better Railway Service Needed in Brazil

The shortage of rolling stock on the Sorocabana Railway continues to draw protests from shippers along its route, according to Assistant Trade Commissioner Cremer at Rio de Janeiro. The latest is against the poor service given to fruit shippers, who claim that shipments are delayed as much as four days or more, the fruit spoiling in the meantime.

The Sorocabana runs through a fertile and rapidly developing part of the state of São Paulo, but has not been able to keep step with the general march of progress. While locomotives and cars are required, the need for repair shops to keep the present rolling stock in running condition is much greater. The building of a second track on the line between São Paulo and Sorocaba and Avare is also being agitated.

The Central of Brazil proposes to buy 37 locomotives, 12 sleeping cars, 12 passenger cars, 6 steel baggage cars, 6 steel mail cars, 550 freight cars, 50 ventilated box cars for carrying meat and 50 refrigerated box cars for carrying milk and fruit on its broad-gage lines. For the narrow-gage lines, 8 locomotives, 4 sleeping cars and 300 freight cars are proposed. The railroad is reported to be suffering from a shortage of rolling stock, and shippers and travelers are said to complain. Expenditures for rolling stock and new construction have been small during the last year, while receipts have steadily increased.

New Locomotive and Car Shop for Southern

The Southern railway has awarded a contract to the Dwight P. Robinson Company, New York, for the construction of a locomotive and car shop at Birmingham, Ala. The shop will be of the transverse type and will include the following buildings: Erecting shop, 80 ft. by 568 ft.; machine shop, 95 ft. by 468 ft.; boiler shop, 100 ft. by 240 ft.; blacksmith shop, 100 ft. by 260 ft.; forge shop, 30 ft. by 80 ft.; flue shop, 50 ft. by 80 ft.; power house, 80 ft. by 90 ft.; storehouse and office, 55 ft. by 200 ft.; paint shop, 24 ft. by 60 ft.; tank shop, 100 ft. by 158 ft.; firing-up shed, 45 ft. by 100 ft.; wash and locker building, 42 ft. by 128 ft. The erecting shop will have 24 tracks, running across its width, and will be served by an electrically operated transfer table of 250 tons' capacity, traveling its entire length. The erecting shop will also be served by one 150-ton overhead traveling crane and two 15-ton

overhead traveling cranes, each running the full length of the building. The machine shop will be served by two 15-ton cranes, running its full length in a 60-ft. bay. The remaining 35 ft. of the machine shop's width will be divided into two floors, the upper being of the mezzanine order. The boiler shop will be served by a 20-ton crane with a 60-ft. span and the boiler, smith and flue shops will be served by a 20-ton crane with 60-ft. span, operating out of doors in an 800-ft. runway. The cranes will operate from the machine shop into the smith shop and from the erecting shop into the boiler shop. The flue shop will be equipped with electric flue welders and modern flue-handling machinery. The car repair shop will include the following buildings: Steel car repair shop, 108 ft. by 598 ft.; annex machine shop, 51 ft. by 156 ft.; wheel shop, 55 ft. by 125 ft.; dry lumber shed, 41 ft. by 240 ft.; woodworking mill, 100 ft. by 243 ft.; paint house, 25 ft. by 50 ft.; scrap deck, 52 ft. by 400 ft.; reclamation shop, 35 ft. by 60 ft.; wash and locker building, 36 ft. by 90 ft. The steel car shop will include three longitudinal bays. One of these will be served by two 15-ton cranes with 35-ft. span and another by two 20-ton cranes with 40-ft. span, all traveling the entire length of the building. Both the locomotive and car shops will be equipped with new machinery throughout. All will be of the latest design and electrically-driven, each machine being equipped with individual motor, so that no overhead shafting will be needed, and each machine will be run only when it is needed.

Large Extension Program for C. P.

The Canadian Pacific has announced a large program of extension and betterment for the current year. For one section of this program that railway has given an order to the Algoma Steel Company for 50,000 tons of 100-lb. rails, 25,000 tons being for the Western lines and 25,000 tons for the Eastern lines. Additional yard trackage will be constructed between Fort William, Ont., and Port Arthur to provide for the new terminal elevators at the head of the lakes. Considerable extensions will also be made to the terminal tracks at Ignace, Kenora, Outlook and Wynyard. Extensions will also be made to the existing trackage at Vermilion, Murillo, Fort Garry, Austin, Virden, Minnedosa, Johnston, Bredenbury, Antler, Tuxford, Cluny, Kirkpatrick, Kneehill, Milk River, Spring Coulee, New Dayton, Calgary, Coleman, Bank, Temple, Duthil, Nisku, Ottertail, Misko, Salmon Arm, Nutchill, Grind Rod, Okanagan Landing, Beavermouth and Vancouver. Extensions will be made to the enginehouses at Outlook and Wynyard, and the mechanical facilities will also be improved at Medicine Hat. At Winnipeg the power house at the main terminal will be completely replaced by one of the most modern design. The station power plant at Calgary will also be remodeled. A Y. M. C. A. building will be erected at Ignace. In Eastern Canada the company will complete the ballasting of the main line between Montreal and Toronto and between Montreal and Ottawa. There will be 44 miles of rock ballast added between Toronto and Fort William and the laying of 150 miles of new 100-pound rails between the two latter points. Station work will include a new station and divisional headquarters at Schreiber, Ont., and grain handling facilities at Port McNicoll, Ont. Passing tracks, industrial tracks and yard extensions will be built at Chesterville, Tay, Lake Shore Junction, Point au Baril, Cache Bay, White River and Heron Bay in Ontario. To handle heavier locomotives a number of steel bridges will be replaced on the Havelock sub-division.

MEETINGS AND CONVENTIONS

Industrial Purchasing Agents to Meet in Boston

The Tenth Annual International Purchasing Agents' Convention and "Informashow" will be held in Boston during the week of May 19, 1924, under the auspices of the National Association of Purchasing Agents. An attendance of some 3,000 is expected at the convention.

Fuel Association Convention

A Committee on Local Arrangements has been appointed to prepare for the International Railway Fuel Association convention to be held at Chicago, May 26 to 29, inclusive. At its initial meeting, the Hotel Sherman was selected as the headquarters for the convention and tentative plans were made for an exhibit of coal, coke, oil and railway supplies at the hotel during the convention week. The members of the Local Committee are W. H. Harris, president of W. H. Harris & Co., coal and coke dealers, chairman; Percival Hunter, Chicago, Burlington & Quincy; L. J. Joffray, Illinois Central; C. H. Dyson, Baltimore & Ohio; T. Duff Smith, Canadian National; Clarence Mellor, Barco Manufacturing Company; A. W. Clokey, American Arch Company; G. D. Cowin, Bell & Zoller Coal Company; Clark T. Roberts, Hedstrom-Schenck Coal Company, and D. B. Sebastian, formerly president of the Sebastian Coal Company.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting Mt. Royal Hotel, Montreal, May 2-5.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention June 11-18, 1924, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Convention June 16-18, 1924, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—J. A. Duca. tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention August 28-30, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que., Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings; first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill. Next meeting Hotel Sherman, Chicago, May 26, 27, 28.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 2-5, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 20-23, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Tuesday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1924.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Truscon Steel Company, Youngstown, Ohio, has leased a building at Erie and St. Clair streets, Chicago, to which it will move its Chicago offices on May 1.

L. H. Welling has been appointed manager of the eastern office of the Graver Corporation, East Chicago, Ind. Mr. Welling's headquarters are at New York City.

Himelblau, Agazim & Co., 30 N. Dearborn street, Chicago, has been appointed Chicago district representative of the Coppus Engineering Corporation, Worcester, Mass.

Herbert Mertz, secretary and sales manager of the Orton-Steinbrenner Company, with headquarters at Chicago, has been elected a director, succeeding H. G. Steinbrenner, resigned.

E. F. Kultchar, district maintenance engineer of the Chicago, Burlington & Quincy, has resigned to join the Ingersoll-Rand Company. Mr. Kultchar will have his headquarters at Chicago, Ill.

The National Malleable Castings Company, Cleveland, O., has changed its corporate name to the National Malleable & Steel Castings Company. There is no change in management or personnel.

Hope E. Scott & Co., Ltd., of 224 St. James street, Montreal, Que., has been appointed representative of the Union Railway Equipment Company, Chicago, in charge of all its Canadian business.

H. E. Hughes, vice-president of the Locomotive Crane Company of America, Champaign, Ill., has been elected president, succeeding Charles Bergan, resigned. He will be succeeded by John Brenza, a director.

J. H. Roberts, until recently vice-president of the Atlas Steel Corporation, has been appointed eastern manager of sales of the Vanadium-Alloys Steel Company, with offices at 143 Liberty street, New York.

Lathrop & Trotter have been appointed Cincinnati representatives of the Conveyors Corporation of America, Chicago. The offices of Lathrop & Trotter are at 733 Union Trust building, Cincinnati, Ohio.

The Okonite Company, Passaic, N. J., has recently opened a branch office at Pittsburgh, Pa., in the First National Bank building. This branch office is in charge of Edward A. Damrau, district manager.

The Sullivan Machinery Company, Chicago, has removed its Birmingham, Ala., office from the Brown Marx building to larger quarters at 2108 Fifth avenue North. G. P. Small is local manager for Alabama.

Richard Trimble, who was secretary-treasurer of the United States Steel Corporation at New York for about 21 years previous to April, 1922, died on February 18 at his home in New York at the age of 66.

Edwin B. Meissner, vice-president of the St. Louis Car Company, with headquarters at St. Louis, Mo., has been elected president and general manager, succeeding John I. Beggs, who has been elected chairman of the board.

Manning, Maxwell & Moore, Inc., has consolidated its Cincinnati, Ohio, and Cleveland offices and has appointed E. H. Merrick, manager of the combined offices, with headquarters in the Huron-Sixth building, Cleveland, Ohio.

C. Garness, mechanical engineer of the American Car & Foundry Company, with headquarters at Chicago, has been appointed supervising engineer of railway car inspection of the Robert W. Hunt Company, with headquarters at Chicago.

The Railway Equipment Company, composed of R. E. Bell and W. H. Reeves, 584 Arcade building, St. Louis, Mo., has been appointed to handle the business of the National Lock Washer Company of Newark, N. J., in southwestern territory.

J. C. Bryan, mechanical assistant to the manager of purchases of the American Short Line Railway Association, has been appointed special engineer in the locomotive headlighting equipment department of the Electric Service Supplies Company, with headquarters at Chicago.

G. P. Rogers, general sales and advertising manager of the Pyrene Manufacturing Company, Newark, N. J., has resigned to become vice-president and director of sales and advertising of the Kant Rust Products Corporation, Rahway, N. J.

Pierce Lewis of the advertising department of the Truscon Steel Company, with headquarters at Detroit, Mich., has been promoted to advertising manager, with headquarters at Youngstown, Ohio, succeeding S. M. Fechheimer, who has resigned.

Walter F. Delaney has been appointed representative of the Hanna Engineering Works, Chicago, manufacturers of Hanna riveting machines, air hoists, sand sifters and I-beam trolleys, with headquarters at 203 Mutual building, Richmond, Virginia.

The Morton Manufacturing Company, Muskegon Heights, Mich., has taken over the sale and distribution of the Robinson patented automatic air hose coupling. This device was described in the December, 1922, number of the *Railway Mechanical Engineer*.

The Paige & Jones Chemical Company, New York, has just completed an addition to its factory building at Hammond, Ind., and is installing considerable new machinery in order to take care of its rapidly increasing business in boiler feed water treatment.

The Pennsylvania Tank Car Company has been consolidated with the Pennsylvania Car Company. The general offices are at Sharon, Pa., and the Pennsylvania Car Company will operate the plants at Sharon, Pa., Kansas City, Kan., and Beaumont, Texas.

B. L. Knowles, manager of the publicity department of the Worthington Pump & Machinery Corporation, New York City, died on February 14 as a result of a cerebral hemorrhage. Mr. Knowles was 45 years old at the time of his death and had spent 28 years with the Worthington Corporation.

James M. Hopkins, chairman of the board of directors of the Ryan Car Company, Chicago, has been elected president, succeeding William M. Ryan, who has resigned, but who will remain as a director and retain his interest in the company. A new chairman of the board will not be elected at present.

J. H. Hackenburg, formerly purchasing agent of the Pressed Steel Car Company, New York, and more recently secretary and treasurer of the Lake Erie Rubber Company, Cleveland, Ohio, has been appointed purchasing agent of the Illinois Car & Manufacturing Company, with headquarters at Hammond, Ind.

J. R. Sexton, who has been in charge of the railroad sales of the H. H. Robertson Company for the past year, has been appointed a district manager with headquarters in Chicago, to succeed the late Hillis F. Hackedorn. Mr. Sexton will remain actively in charge of railroad sales as well as supervise sales in other fields.

E. L. Lord, sales engineer of the San Francisco, Cal., branch of the Electric Storage Battery Company, Philadelphia, Pa., has been assigned to handle the railway sales for that office. He will also supervise the railway business for the Pacific district, which comprises six of the Pacific Coast states and part of Montana.

The Dempster Equipment Company, Inc., Knoxville, Tenn., has been incorporated to rebuild locomotives and freight cars and has purchased 14 acres of land at Knoxville on which the plant will be erected. George R. Dempster is president, Robert P. Thompson is vice-president and treasurer and Thomas G. Shea is secretary.

The National Car Wheel Company, with main plant in West Homestead, Pa., has been sold to the American Brake Shoe & Foundry Company, New York. The annual output of the company is 120,000 tons. J. D. Rhodes, chairman of the board of the National Car Wheel Company and George P. Rhodes, president, have resigned. Joseph B. Terbell has been elected chairman of the National Car Wheel Company. W. F. Cutler, president, F. C. Turner, first vice-president, George M. Judd, secretary, Andrew Muirhead, treasurer, and the other officers of the National Car Wheel Company, remain as formerly.

The Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., has placed a contract with the Hughes-Foulkrod Company and the McClintic-Marshall Company, for the construction of a steel and brick wood mill 350 ft. by 204 ft., with three aisles, each

equipped with traveling cranes. The contract also includes a power house 40 ft. by 98 ft. The approximate cost of these buildings is $200,000. The Mt. Vernon Car Manufacturing Company has just completed a new blacksmith shop 350 ft. by 100 ft., equipped with a traveling crane, arranged for use between the shop and the yard, at an approximate cost of $150,000. In addition this company has completed a repair shed 500 ft. by 100 ft., equipped with double bridge traveling cranes for the repair of freight cars.

Hobart Ames, for nearly 23 years president of the Ames Shovel & Tool Company, Boston, Mass., has resigned and Alfred C. Howell, who was for many years connected with the Bethlehem Steel Company, has been elected as his successor, Mr. Howell having previously been elected a director. Mr. Ames will remain as one of the directors, but intends to devote more of his time to his private interests and to no longer act as the chief executive of the company. Mr. Howell's connection with the steel industry extends over a long period of years, he having served in various responsible positions in Bethlehem, Philadelphia, Cincinnati and Pittsburgh with the Bethlehem, Midvale and Carnegie Steel Companies and for a few years as manager of the steel department of the W. Bingham Company, Cleveland, Ohio.

Paul J. Kalman has been appointed chairman of the board of directors of the Globe Steel Tubes Company, with headquarters at St. Paul, Minn. Frank J. O'Brien, vice-president and general manager, has been elected president, with the same headquarters, to succeed Mr. Kalman and John W. Floto has been promoted to vice-president and general manager. Mr. Kalman was born on April 1, 1879, at New York. He entered railway service in 1897, with the Chicago Great Western. In 1901 he entered the railway supply business as president of the Paul J. Kalman Company, which company later branched out into the reinforced steel and building products business and changed its name to the Kalman Steel Company in 1922. In 1919 he also organized and became president of the Hudson Motor Company of Illinois, and on January 1, 1920, was also elected president of Bliss & Laughlin, Inc., Harvey, Ill. In August, 1922, he became president of the Globe Steel Tubes Company, Chicago, which company at that time took over the business of the Globe Seamless Steel Tubes Company, Milwaukee, Wis. Mr. Kalman is also president of the Kalman Floor Company, which was organized in 1916.

Paul J. Kalman

T. H. Goodnow, superintendent of the car department of the Chicago & North Western and vice-chairman of the Mechanical Division of the American Railway Association, with headquarters at Chicago, has been elected first vice-president of the Ryan Car Company, with headquarters at Chicago. Mr. Goodnow was born on July 22, 1872, at Lathrop, Mo., and entered railway service on July 23, 1890, with the Lake Shore & Michigan Southern (now a part of the New York Central). In November, 1904, he was promoted to general foreman of the car department with headquarters at Air Line Junction, Ohio, which position he held until August, 1906, when he was promoted to division master car builder of the Lake Shore & Michigan Southern, the Chicago, Indiana & Southern, and the Indiana Harbor Belt. In January, 1912, he was appointed general superintendent of shops of Armour & Co., with headquarters at Chicago. He entered the employ of the Chicago & North Western in August, 1912, as assistant superintendent of the car department, with headquarters at Chicago, and was given charge of the car department in February, 1913. In October, 1918, he was appointed to the position of superintendent of the car department, which position he has held until the time of his recent appointment.

TRADE PUBLICATIONS

Soot Blowers.—A four-page illustrated folder, descriptive of the Bayer type S valve-in-head soot blower, has recently been issued by the Bayer Company, St. Louis, Mo.

Motor-Driven Grinder.—A new wide swing floor stand grinder is described and illustrated in Bulletin No. 3016-S, recently issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio. The wheels of the grinder are of wide spacing (37 in.) to permit grinding of large, bulky castings and many other irregular shaped pieces.

Vises.—A 28-page catalogue, designed particularly for superintendents, master mechanics and shop foremen, has recently been issued by the Charles Parker Company, Meriden, Conn. The catalogue carries in blue print form drawings relative to vise construction and repair parts. Details of the complete Parker line are also given.

Cinder Handling Plant.—Roberts & Schaefer Company, Chicago, has issued a four-page folder illustrating and describing the Junior N. & W. type cinder plant. In addition to a general description there is included a list of 10 advantages claimed for this equipment as regard considerations affecting the construction, operation and maintenance of such plants.

Oil-Burning Equipment.—The Mahr Manufacturing Company, Minneapolis, Minn., has recently issued a 64-page illustrated catalogue descriptive of its various types of railroad and industrial oil-burning equipment, including torches, burners, furnaces, ladle heaters, ovens, blowers, etc. W. M. Horner, president of the company, also has written an eight-page brochure entitled, "Co-operation Between the Buyer and Seller," in which the principles and practices governing the sale of Mahrvel products are set forth.

Stampings.—"Heavy Stampings" is the title of a booklet just issued by the Federal Pressed Steel Company, Milwaukee, Wis. The illustrations show numerous examples of how the use of Federal pressed steel parts has resulted in lowering production costs and improving design. Uniformity of product, minimum weight with maximum strength and reduced amount of machining required are some of the advantages emphasized. Pages are also devoted to illustrations and descriptions of Federal disk wheels and bumpers.

Power Reverse Gear.—The Barco Manufacturing Company has recently brought out catalogue No. 94, outlining in a simple and concise way the advantages of the Barco power reverse gear. The arrangement of this gear for either air, steam or hand operation is explained; also the use of a worm and gear to hold the point of cut-off, thus tending to prevent cushioning and creeping. Several illustrations are included showing the gear in phantom and as it is applied to locomotives. A large scale drawing in partial cross section shows all detailed parts of the gear, giving the name of each part.

Electric Traction.—The Westinghouse Electric & Manufacturing Company has recently released a 54-page publication entitled, "A Brief Outline of the Development and Progress of the Electric Railway Industry." This booklet sets forth in a brief and concise manner the history of the electric railway industry, from the installation of the first permanently fixed rails to the production of the powerful electric locomotives of today. A wealth of illustration, including photographs of modern equipment and sketches of the earliest railway apparatus, adds greatly to the interesting character of the publication.

Ordering Flexible Joints.—The ordering of Barco flexible joints of all kinds is greatly facilitated by means of a four-page catalogue No. 101, recently issued by the Barco Manufacturing Company, Chicago. This catalogue contains illustrations of the various kinds of flexible joints made by this company with designating figures and letters which will enable parts to be ordered with little if any possibility of error. On the last page of the catalogue is a table showing the dimensions of these various parts and the joint sizes. A schedule for ordering automatic smoke box blower fittings is also included on the last page.

PERSONAL MENTION

General

WILLIAM MARTIN has been appointed general mechanical inspector of the Missouri Pacific, with headquarters at St. Louis, a newly created position.

F. K. TUTT, superintendent of motive power of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has resigned and his position has been abolished.

O. P. REESE, superintendent of motive power of the Pennsylvania, with headquarters at Chicago, has been appointed assistant general superintendent of motive power, with headquarters at Ft. Wayne, Ind.

R. G. HENLEY, master mechanic of the Norfolk & Western, with headquarters at Portsmouth, Ohio, has been promoted to assistant to the superintendent of motive power, with headquarters at Roanoke, Va.

G. B. FRAVEL, superintendent of motive power of the Pennsylvania, with headquarters at Columbus, Ohio, has been appointed assistant general superintendent of motive power, with headquarters at St. Louis, Mo.

S. E. MITCHELL, chief draftsman in the mechanical department of the Chicago & Northwestern at Chicago, has been promoted to assistant to the general superintendent of motive power and machinery, with the same headquarters, succeeding W. E. Dunham.

C. Y. THOMAS, instructor of apprentices on the Atchison, Topeka & Santa Fe, with headquarters at Fort Madison, Ia., has been appointed supervisor of apprentices on the Kansas City Southern, with headquarters at Pittsburgh, Kan., a newly created position.

M. C. M. HATCH, assistant to the executive vice-president of the Missouri-Kansas-Texas, with headquarters at St. Louis, Mo., has been promoted to general mechanical superintendent, with headquarters at Dallas, Tex., with jurisdiction over the locomotive and car departments.

J. P. DOWNS, superintendent of shops of the Missouri Pacific at Sedalia, Mo., has been promoted to assistant mechanical superintendent, with headquarters at Little Rock, Ark., a newly created position. He will have jurisdiction over the St. Louis terminals (east side of river), the Illinois, the Missouri, the Arkansas, the Memphis, the Louisiana and the Central divisions.

W. G. SEIBERT, general master mechanic of the Missouri Pacific, with headquarters at Kansas City, Mo., has been promoted to assistant mechanical superintendent, with the same headquarters, a newly created position. He will have jurisdiction over the St. Louis terminal (west side of river), the Eastern, the Joplin, the White River, the Kansas City terminal, the Omaha, the Northern Kansas, the Central Kansas, the Colorado, the Wichita and the Southern Kansas divisions. The position of general master mechanic at Kansas City has been abolished.

M. F. COX, whose promotion to assistant superintendent of machinery of the Louisville & Nashville, with headquarters at Louisville, Ky., was reported in the February *Railway Mechanical Engineer*, was born in Essex county, Virginia. Mr. Cox was first employed by the American Locomotive Company as a special apprentice where he served for a time in each department, including foundry, machinery and erecting shop, boiler shop and blacksmith shop. He was then assigned to the drafting department, in which he continued until he was promoted to mechanical engineer. He also served at the Richmond Locomotive Works in a similar capacity, entering railway service in 1911 as mechanical engineer of the Louisville & Nashville. Mr. Cox continued in this capacity until his promotion to assistant superintendent of machinery.

B. N. LEWIS, whose promotion to mechanical superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Fond du Lac, Wis., was reported in the February *Railway Mechanical Engineer*, was born on August 22, 1883, at Austin, Minn. He entered railway service in June, 1901, as a machinist and draftsman apprentice on the Minneapolis, St. Paul & Sault Ste. Marie, at Minneapolis, Minn. In July, 1903, he was appointed special apprentice on the Erie at Meadville, Pa., and continued in this position until April, 1906, when he was appointed shop inspector in the Franklin plant of the American Steel Foundries. Mr. Lewis returned to railway service in January, 1908, as a gang foreman on the Erie and in February, 1909, he was appointed roundhouse foreman on the Minneapolis, St. Paul & Sault Ste. Marie. From June, 1911, to May, 1915, Mr. Lewis was engaged in special shop work at Minneapolis and on the latter date was promoted to mechanical valuation engineer. He was promoted to assistant mechanical superintendent in November, 1917, and he held this position until his recent promotion to mechanical superintendent.

Master Mechanics and Road Foremen

O. W. JUDD has been appointed master mechanic of the White River division of the Missouri Pacific, with headquarters at Crane, Mo.

H. W. REINHARDT has been appointed master mechanic of the Missouri division of the Missouri Pacific, with headquarters at Poplar Bluff, Mo.

R. H. HALE has been appointed master mechanic of the Alaska Railroad, with headquarters at Anchorage, Alaska, succeeding F. C. Ferrell, who has resigned.

S. N. WOODRUFF, master mechanic of the Minnesota division of the Minneapolis, St. Paul & Sault Ste. Marie, has retired after 37 years of service with the company.

O. F. HARK, master mechanic of the Norfolk & Western, with headquarters at Bluefield, W. Va., has been transferred to Portsmouth, Ohio, succeeding R. G. Henley.

G. H. LANGTON has been appointed general master mechanic of the eastern general division of the Chesapeake & Ohio, with headquarters at Clifton Forge, W. Va.

C. R. KILBURY has been appointed master mechanic of the Southern Kansas division of the Missouri Pacific, with headquarters at Coffeyville, Kan., succeeding G. K. Stewart.

L. A. MITCHELL has been appointed master mechanic of the East Bay electric division of the Southern Pacific, with headquarters at West Alameda, Cal., succeeding J. H. Lockett, deceased.

T. F. BARTON has been appointed general master mechanic of the western general division, except Huntington general shops, of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

J. L. BARRY, general foreman of the Norfolk & Western, with headquarters at Columbus, Ohio, has been promoted to master mechanic, with headquarters at Bluefield, W. Va., succeeding O. F. Hark.

J. J. SIMMONS, road foreman of locomotives of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been appointed acting assistant master mechanic of the Hannibal division, with headquarters at Hannibal, Mo.

A. J. LEWIS, general master mechanic of the Missouri-Kansas-Texas of Texas, with headquarters at Denison, Tex., has been appointed master mechanic of the North Texas district, with the same headquarters and the position of general master mechanic has been abolished.

ARTHUR G. GREENSETH has been appointed master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Enderlin, N. D. Mr. Greenseth was born at Clintonville, Wis., January 14, 1888. He entered railroad service in 1903 as a machinist apprentice on the Great Northern at Superior, Wis. In 1908, he was transferred as air brake man in the roundhouse at Devil's Lake, N. D. During 1909 and 1910, he served as a machinist on the A. T. & S. F., the C. G. W., the C. & N. W. and the C. M. & St. P. In March, 1911, he entered the service of the Soo Line as a machinist, and in June, 1913, was promoted to round house foreman, with headquarters at Bismarck, N. D. He was transferred in the same capacity to Thief River Falls, Minn., in

April, 1915. During the World War, he served with the Russian Railway Service Corps in Siberia. Upon being discharged in June, 1919, from the service, he returned to Thief River Falls as roundhouse foreman and served in that capacity until February 1, 1923, when he was transferred to Shoreham. Here he held the position of roundhouse foreman until promoted, February 1, 1924, to his present position.

GEORGE K. STEWART, formerly master mechanic of the Missouri Pacific at Coffeyville, Kan., has been appointed master mechanic of the same road at Atchison, Kan. Mr. Stewart was born at Ottawa, Kan., on August 5, 1869. In 1886, he graduated from the Ottawa high school and entered railroad service on the Santa Fe at Topeka, Kan., as a machinist apprentice, August 1, 1889. Upon the completion of his service as an apprentice in 1893, he worked as a machinist at Ottawa, Kan., until August 10, 1898. At this time he entered the employ of the Missouri Pacific and served as a machinist at Osawatomie, Kan., and Coffeyville from 1898 to 1904, and from 1904 to 1906, respectively. On July 1, 1906, he was promoted to roundhouse foreman at Coffeyville and served in that capacity until September 23, 1909, when he was appointed division foreman, with headquarters at Wichita, Kan. On March 4, 1912, he was appointed master mechanic, with headquarters at Coffeyville. He served in the same capacity from February 12, 1914, to January 10, 1919, at Poplar Bluff, Mo., and in the Desoto back shop. He returned to Coffeyville where he served as master mechanic until his present appointment, February 1, 1924.

G. K. Stewart

Car Department

C. I. MOTT, formerly general car inspector of the Havana Terminal Railway, office estacion Central, has been appointed general car foreman of the Luyano shops of the Havana Central and United Railways of Havana.

E. J. ROBERTSON, superintendent of the car department of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn., has had his jurisdiction extended to cover the entire system.

S. O. TAYLOR, chief mechanical inspector of the mechanical division of the American Railway Association, with headquarters at Chicago, has been appointed master car builder of the Missouri Pacific, with headquarters at St. Louis, Mo., a newly created position.

W. E. DUNHAM has been promoted to superintendent of the car department of the Chicago & North Western, with headquarters at Chicago. Mr. Dunham was born at Newark, N. J. He graduated from Cornell University in 1895 and entered railway service in 1896 in the shops of the Chicago, Rock Island & Pacific, at Horton, Kans. He was promoted to draftsman at Chicago in 1898, and in 1901, he was promoted to master mechanic at Dalhart, Tex. Mr. Dunham entered the service of the Chicago & North Western in 1902 as chief draftsman in the mechanical department at Chicago and in 1903, he was promoted to mechanical engineer. He was promoted to master mechanic at Winona, Minn., in 1906, and held this position until 1910, when he was promoted to supervisor in the motive power and car department. He was promoted to assistant to the general superintendent of the motive power and car department in 1917, and in 1921, his title was changed to assistant to the general superintendent of motive power and machinery. Mr. Dunham continued in this position until his recent promotion to superintendent of the car department.

Shop and Enginehouse

J. W. HENDRICKS has been appointed general foreman of the Norfolk & Western, with headquarters at Crewe, Va., succeeding F. R. Forrest.

F. R. FORREST has been appointed general foreman of the Norfolk & Western, with headquarters at Bluefield, W. Va., succeeding F. D. Veazey.

F. D. VEAZEY has been appointed general foreman of the Norfolk & Western, with headquarters at Columbus, Ohio, succeeding J. L. Barry, promoted.

Purchasing and Stores

W. L. OSWALT has been appointed assistant general storekeeper of the Pennsylvania, with headquarters at Altoona.

S. I. GOWLAND, assistant general storekeeper of the Central region of the Pennsylvania, has been transferred to Philadelphia.

O. V. DANIELS, assistant general storekeeper of the Eastern region of the Pennsylvania, has been transferred to Philadelphia, Pa.

J. S. MATTHIAS has been appointed general storekeeper of the Texas & Pacific, with headquarters at Marshall, Texas, succeeding F. S. McClung.

R. C. HARRIS, general storekeeper of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been transferred to Philadelphia, Pa.

W. F. VOGT, works storekeeper of the Pennsylvania, with headquarters at Altoona, Pa., has been promoted to general storekeeper, with the same headquarters.

F. S. MCCLUNG, general storekeeper of the Texas & Pacific, with headquarters at Marshall, Texas, has been promoted to purchasing agent, with headquarters at Dallas, Texas.

C. R. PEDDLE, purchasing agent of the Southwestern region of the Pennsylvania, with headquarters at St. Louis, Mo., has been appointed assistant purchasing agent, with the same headquarters.

W. G. PHELPS, purchasing agent of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed assistant purchasing agent, with the same headquarters.

G. W. SNYDER, general storekeeper of the Eastern region of the Pennsylvania, with headquarters at Philadelphia, Pa., has been appointed assistant to the stores manager, with the same headquarters.

C. W. KINNEAR, general storekeeper of the Northwestern region of the Pennsylvania, with headquarters at Chicago, has been appointed assistant general storekeeper, with headquarters at Altoona, Pa.

W. W. MORRIS, purchasing agent of the Northwestern region of the Pennsylvania, with headquarters at Chicago, has been appointed assistant purchasing agent, with headquarters at Philadelphia, Pa.

C. E. WALSH, assistant purchasing agent of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed assistant purchasing agent, with headquarters at Philadelphia, Pa.

A. E. OWEN has been promoted to assistant purchasing agent of the Pennsylvania, with headquarters at Chicago. Mr. Owen was born on March 27, 1880, at Camden, N. J. He entered railway service in April, 1896, in the department of the auditor of passenger receipts of the Pennsylvania at Philadelphia. He was transferred to the purchasing department in June, 1899, and subsequently held various positions in that department. In 1914 he was detailed to represent the purchasing department with Messrs. Gibbs and Hill, consulting electrical engineers, who were constructing the Philadelphia, Paoli and Chestnut Hill electrification. In 1917, Mr. Owen was appointed chairman of a committee which took over the management and supplying of commissaries of labor camps on the Pennsylvania lines east of Pittsburgh and Buffalo, and in 1919 he was promoted to equipment agent. He was appointed assistant to the purchasing agent of the Northwestern region, with headquarters at Chicago, in March, 1920, and continued in that position until his recent promotion to assistant purchasing agent.